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PRIMARY SCHOOL PUPILS' ABILITY TO USE AERIAL PHOTOGRAPHS AND MAPS IN THE SUBJECT OF GE OGRAPHY

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Abstract:
This research examined the abilities of Primary school pupils in using maps and aerial photographss. The results referred to 36 eleven year olds pupils from two different schools, on Lesvos Island (Greece). The research approach implemented was the before and after instructive intervention comparison. Research results illustrate that pupils' ability to recognize, locate and interpret map symbols was significantly improved after instructive intervention. There was also an important difference in pupils' ability to distinguish environmental features and to determine the relative location of their school in the aerial photograph. But there was not a significant difference on estimating familiar distances.

Keywords: *map skills, cartographic symbols, aerial photograph, primary education, geography.*

1. INTRODUCTION

This research is an initial investigation of the abilities of primary school pupils to use aerial photographs and maps, to identify and interpret map symbols, to have a sense of familiar geographical space, to distinguish the natural and human environment features, to determine relative location and estimate distances within the context of the subject of Geography taught in 5th grade at Greek Schools.

The objective of the research is based on the National Curriculum for Geography for Greek Compulsory Education, which mentions, among other things, that the goal of teaching Geography is "…to strengthen students' basic knowledge, specialised information, methods and techniques that contribute to the comprehension of geographical space structure as well as to the interpretation of interdependence between geophysical and social factors". Furthermore, according to the same source, "…the development of abilities relevant to the application of methods related to the subject's nature, such as space observation, mapping and the use of verbal, quantitative and symbolic forms of data". (Official Gazette, issue B, nr 304/13-3-03; p.474-475). In addition the literature indicates that the abilities of reading, decoding and drawing maps constitutes long-lasting fundamental skills, very useful in life and with great pedagogical value that strengthens learning in all aspects of the curriculum (Piaget, 1973; Nelson, 1985). Blaut (1991, 1997) claimed that "understanding environmental representations such as aerial photographs was a natural, untrained ability in young children" and this suggestion was based on studies such as Stea and

Blaut (1973). More over thorough reviews of research on young children's environmental cognition and mapping behavior are given in two books: Spencer et al.'s *The Child in the Physical Environment: The Development of Spatial Knowledge and Cognition* (1989) and Mathews's *Making Sense of Place: Children's Understanding of Large –Scale Environment* (1992), *i*n which support the position that "children can understand and use maps at or even before the age of school entrance". It is also pointed out by Uttal (2000) that "experience with spatial representations (maps, aerial photographs) is likely to scaffold the development of a mature understanding of space", while Plester, Blades and Spencer (2003; p. 281, 292) mention that "understanding the relationship between distance on a map or a photograph and distance in the real world is an important aspect of geographical understanding".

2. RESEARCH SAMPLE

The research was aimed at evaluating the ability of 36 pupils (16 boys and 20 girls, belonging to two classes in two different schools in the city of Mytilene) in the use of maps and aerial photographs. In order to accomplish these goals the well known research approach of comparing student's ability before and after an instructive intervention was applied (Hartley, 1973; Toth, Klahn, Chen, 2000; Rockland, 2001; Muij, 2004; Mark, 2005; Ding, et al., 2008; Rorbach, 2009; O'Hannon, Diaz, 2010; Heckler & Sayre, 2010). As a result the research consisted of two phases. During the first research phase the pupils were assessed on the use of maps and aerial photographs before any instructive intervention from the researcher. During the second phase, the same pupils were involved in a cooperative learning and role playing instructive intervention that lasted two hours and consisted mainly of the creative use of the geotouristic map of Lesvos and an aerial photograph of the city of Mytilene. The same material was used in both phases of the research and the pupils answered the same questions.

It should be emphasized that, in both phases of the research, there were no significant differences in the results from a statistical point of view with regard to sex, pupil nationality (91,7% Greek nationality), or the educational level of their families (the 69,4% of children belong to families of educated parents).

3. RESEARCH TOOL

In order to carry out the research, the following materials were used: a geotouristic coloured map of Lesvos Island of 1:200000 scale (dimension: 70cm x100cm) (Figure 1), on which there was hidden the explanation of the legend's symbols; one aerial photograph of the city of Mytilene of 1:15000 scale (dimension: 100cm x 70cm) (Figure 2); a text-tourist guide, about Lesvos (given only in the second phase); and a four-page questionnaire with closed and open-ended questions related to the investigation.

Figure 1. Geotouristic map of Lesvos

Figure 2. Aerial photo of Mytilene

In the first phase all pupils were required to answer a questionnaire. In the questionnaire, the first page contained questions about the pupil's demographic data; the next two pages had questions about elements of the map. More specifically it contained questions about:

- The identification of the legend symbols
- The recognition and the location of areas with the same symbol on the map. The symbols selected for the specific question were the church-monastery, the bridge and the thermal springs, symbols that appear in various places on the map.
- The identification of linear symbols (road network), namely 3 road categories.

Finally, the fourth page contained questions about the aerial photograph and consisted of four questions. The first two questions asked the pupils to distinguish features of the natural and human environment found in the aerial photo; then, to identify the location of their school in relation to the stadium – a very characteristic location of the city of Mytilene - and finally to estimate a familiar distance (i.e. the distance between the stadium and the swimming pool).

In the second phase in the questionnaire there was also another page (second page) that was allocated to an activity (a scenario with a role play game), which the pupils had to complete first in order to answer the questions related to the map and the aerial photo. For this purpose the pupils were divided into three groups: in the first group, the tour operators, the pupils had to organize different sightseeing tours on the island. The second group, the tourist officers of the municipality, had to provide the island maps, aerial photos of the Mytilene city and information about the island, both groups had a text-tourist guide about Lesvos. The third group of pupils, the tourists-visitors, had to choose either a tour that the tour operators offered or sightseeing tour in the city of Mytilele, or a self organised tour by a rented car, and to justify their choices. The aim of these activities was to familiarize the students with the use of the map and the aerial photo. The choice of this teaching strategy justified from many researches who argued that the collaborative work with maps increasing pupils interesting and understanding of scale, projections and symbology (MacEachren, 1995; Leinhardt *et al*., 1998; Wiegand, 2002a, 2002b; Owen, 2003; Tshibalo, 2003). Further more the role playing as a teaching strategy offers several advantages for both teacher and student. Role play in the classroom involves students actively in the learning process by enabling them to act as stakeholders in an imagined or real scenario. Researchers have shown that "integrating experiential learning activities in the classroom increases interest in the subject mater and understanding of content" and …. "when students are not passive observers of the teaching process, true learning take place". (Poorman, 2002: p. 32; Fogg, 2001; Killen, 2006: p. 261-274).

After this activity the pupils were asked to fill the same questionnaire as in the first phase. The research results, as presented below, show that the activity completed by the pupils was of great importance, since it reversed significantly some of their first phase responses.

The pupils' encoded answers were processed using the "SPSS 14.0" statistical package, and the results were examined next in order to investigate whether factors such as sex, pupil nationality and educational level of their families have an effect upon the abilities of pupils regarding the use of map and aerial photos in the subject of Geography. A series of two way tables were created, these tables however, did not show any difference. Finally, a T-test was utilized in order to discover any differences between the results before and after the intervention.

4. RESEARCH RESULTS

In order to facilitate comparison, the results of the research, before and after intervention, were presented in the tables. It could thus be easily established whether there had been any improvements in the pupils' skills and abilities to use the map or the aerial photograph within the context of the subject of Geography.

In terms of map symbols' identification in both phases (Table 1), the pupils were able to identify most of the map symbols relevant to man-made features such as, airport, church-monastery, port, castle, water/wind mill, bridge, etc, but few of the physico-geographical symbols (wetlands, thermal springs, faults, caves, etc). The attempted identification of these symbols was the result of the children's effort to interpret the pictures. Sometimes, they were close to or actually found the interpretation, but in most cases they were misled by their imagination. For instance, several children identified the volcano symbol as a mountain, the museum symbol as an archeological site, the fossils location symbol as a forest, the thermal spring symbol as a fountain and the wetland symbol either as a zoo or a poultry farm! Some symbols were impossible to guess, no matter how hard they tried; such as faults or rocky formations, etc.

Table 1. Symbols identification

Map symbols	Correct (%)		Incorrect (%)		No answer (%)	
	before	after	before	after	before	after
Church-Monastery	72,20	94,40	,00	5,60	27,80	,00
Airport	75,00	88,90	,00	,00	25,00	11,90
Port	66,80	86,10	,00	,00	33,30	13,90
Bridge	19,40	66,70	2,80	11,10	77,80	22,20
Castle	61,10	63,90	,00	13,90	38,90	22,20
Fossils	2,80	61,20	33,30	19,40	63,90	19,40
Volcano	36,10	52,80	19,40	13,90	44,50	33,30
(Water/Wind) Mill	50,00	51,00	2,80	5,50	47,20	43,50
Thermal springs	,00	44,40	27,80	11,10	72,20	44,40
Wetlands	13,90	33,30	33,30	22,20	52,80	44,40
Roads	11,10	30,60	2,80	,00	86,10	69,40
Archaeological site	19,40	28,80	19,40	21,20	61,20	50,00
Museum	13,20	25,00	30,60	27,80	55,50	47,20
Caves	2,80	25,00	33,30	33,30	63,10	41,70
Rocky formations	,00	16,70	25,00	13,90	75,00	69,40
Quarries-Mines	5,60	14,40	30,50	22,20	63,90	63,40
Faults	,00	13,09	2,80	19,40	97,20	66,70
City (Capital)	,00	11,10	,00	19,40	100,00	69,40
Village	2,80	11,10	11,10	27,80	86,20	61,10

A closer examination of Table 1 indicates that the results can be classified into three categories.

The first category contains symbols which obviously indicate what they stand for and some that are familiar because of the particularity of the area; these were identified by over the 50% of the pupils.

The second category contains mainly physico-geographical symbols, which are typical of Lesvos and were identified by 25% to 44,4% of the pupils.

The third category contains geomorphological and some important anthropogeographical symbols which were only identified by a few pupils.

It is worth mentioning that over 50% of the pupils were not familiar with the terms “linear symbols” and “road network” and, mainly, they were not able to mention the road categories (e.g. national road, main provincial road, etc). It is rather disappointing that only a few pupils were able to distinguish between the symbol for the cities-capitals of Municipalities, Mytilene included, and the symbol for villages.

As for the identification and location of specific symbols (church-monastery, bridge and thermal springs) on more places on the map, the results in the second phase (Table 2) of the research definitely improved when compared to the first. This can be justified by the fact that, in the first phase 44,4% of the pupils had not responded at all to the specific question and of all the answers provided, only the church symbol was simultaneously identified and located on the map by 25%.

Table 2. Identification and location of certain map symbols (after intervention)

Map symbols	Symbol & Place (%)	Only symbol (%)	Only place (%)	Incorrect (%)	No answer (%)
Church-Monastery	77,8%	11,1%	2,8%	5,6%	2,8%
Bridge	50,0%	11,1%	8,3%	5,6%	25,0%
Thermal springs	38,9%	2,8%	5,6%	11,1%	41,6%

With regard to the aerial photograph and pupils' ability to distinguish elements of the natural and human environment, the results show that the majority of the children were able to tell them apart.

Three natural environment elements were identified by the pupils, namely the trees, the mountain and the sea. The number of children and the elements they identified after the intervention are shown in Figure 3. A total of 25% (2,8% before) of the pupils identified only one element, 44,4% (33,3% before) of the pupils identified two elements, and only 25% (11,1% before) of them were able to identify all three of them; 5,5% (55,8% before) did not respond at all. It should be noted that the pupils failed to utilise the appropriate geographical terms (forest, hills, gulf, coast etc.) to describe the concrete elements on the aerial photograph.

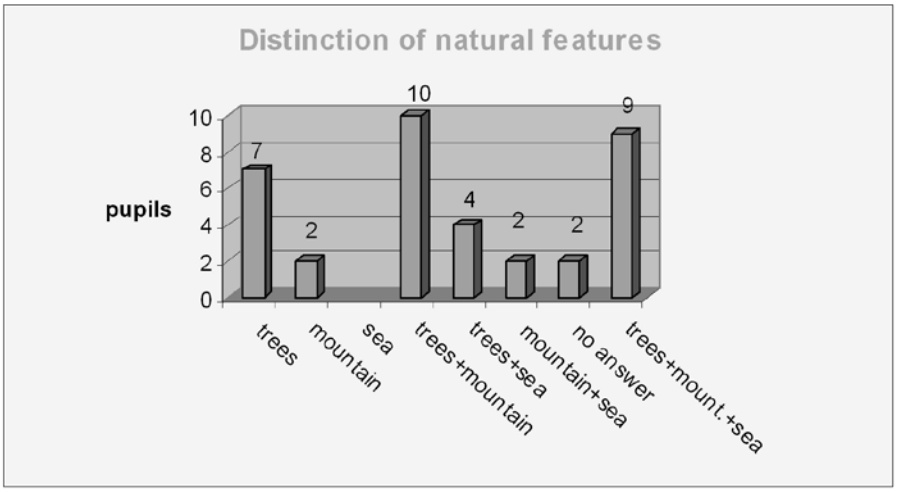

Figure 3: Distinction of natural features (after)

As far as the human environment elements are concerned, the results were far better in both research phases. Eight elements in total were identified. From these eight elements, the houses, the stadium and the port were identified by 50% of the students, the roads and the airport by 25-44,5% of the students, while the parks, the castle and the swimming pool by almost 5-10% of the students. I should also mention that 60% of the pupils identified more than three elements. A significant difference between the two phases of the research is the following: in the first phase (before the intervention), 33,3% of the students had not responded, whereas in the second phase (after the intervention), none of the children failed to respond to the specific question.

In order to check the children's ability to locate a relative position, they were asked to identify one of their familiar areas on the aerial photograph, using the symbol of north sign properly, and, more specifically, to identify the location of their school in relation to the stadium, which is one of the well known locations in the city of

Mytilene. The result of this procedure showed definite improvement as compared to the first phase of the research, but still, it was not particularly satisfactory. Even though all the students responded to this question, whereas before 42,7% of them had not responded at all, only 44,4% (0,0% before) of them responded correctly and 55,6% (58,3% before) gave a wrong answer.

Finally in terms of the estimation of familiar distances, the results were not completely satisfactory (from 2,8% to 8,3%), that is only three pupils answered correctly, while providing outrageous estimations for a distance of 1km (e.g. 1000km, 10km, 140m, etc).

In particular, they were asked to calculate or estimate the distance between the stadium and the swimming pool, without, however, highlighting the usage of the scale, in order to see their way of thinking, their sense of distance and the actual calculation they would come up with. Both locations are situated in the city centre and the route is quite common for both the city dwellers and the pupils.

Figure 4 clearly shows the result of this effort, where only 8,3% of the pupils responded correctly (in the first phase, only 2,8% had responded correctly, 52,8% were wrong and 44,4% had not responded at all).

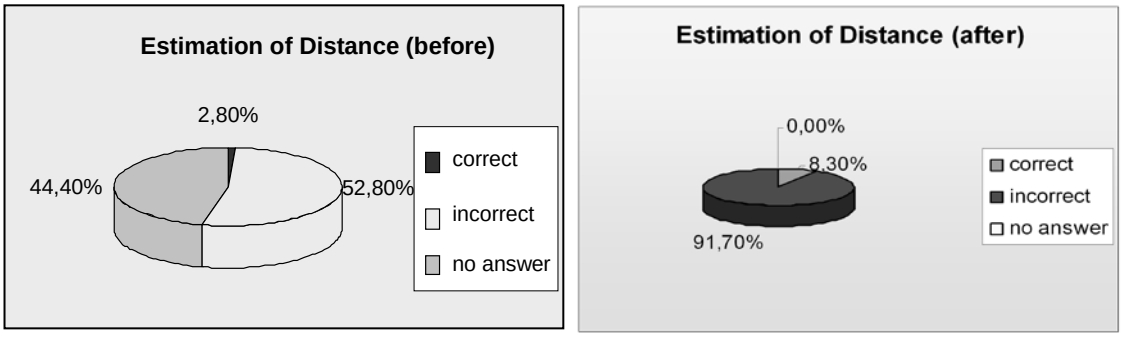

Figure 4(a), (b): Estimation of distance before (a) and after (b) the intervention

In order to facilitate comparison, the results of the research, before and after the intervention a T-Test used (Table 3). The results of the T-Test clearly indicate that there had been significant improvements in the pupils' skills and abilities to use the map or the aerial photograph within the context of the subject of Geography.

Table 3. Results of the **T-Test**

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	corbefore & corafter	19	,848	,000
Pair 2	incorbefore & incorafter	19	,647	,003
Pair 3	noanswebefor & noansweafter	19	,796	,000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	corbefore - corafter	-19,27842	15,09381	3,46276	-26,55340	-12,00344	-5,567	18	,000
Pair 2	incorbefore - incorafter	-,67368	10,69662	2,45397	-5,82929	4,48192	-,275	18	,787
Pair 3	noanswebefor - noansweafter	19,90000	14,12063	3,23949	13,09407	26,70593	6,143	18	,000

5. CONCLUSIONS - SUGGESTIONS

After the research, results had been processed and studied; pupils generally appeared to have greatly improved their mapping skills after teaching intervention. More specifically, being at greater ease with identifying pictorial symbols and, in particular, with ones that did not cause them misconceptions. However, they were significantly weak in categorizing basic points and linear symbols used in almost all school maps and locating them in other places on the map. This indicates that pupils did not become familiar with the use of appropriate geographical terms, and, that they received little previous attention working with maps. This fact is perhaps not surprising; in Greek schools, geography is a secondary subject in school curricula, and there exist no geography teachers per se in service, that is why geography is usually taught by teachers that have poor knowledge of geography subject matter. Furthermore, in the Greek educational system, up to date, the vast majority of teachers use teacher-centered strategies in teaching, which tend not to be especially effective. In addition, teachers' variable attitudes toward the subject of geography itself (negative attitude generally prevailing vis-à-vis geography) highly affect their way of teaching geography and, consequently, students' learning (Katsikis, 2001, 2004; Klonari & Koutsopoulos, 2005; Lamprinos et al., 2002; Rellou & Lamprinos, 2004).

Additionally, pupils indicated poor knowledge of the physico-geographical features of their locality. In the present research, children processed the map of their homeland and the aerial photograph of the city they live in. This, of course, points to the fact either that teachers do not teach the elements in the class or that there has been improper implementation of the subject's Curriculum. It is perhaps a fact that children do not "see" their local environment (Klonari *et al*, 2011), i.e. they do not have spatial skills. We have come to this conclusion, because the use of examples

derived by the pupils' local environment and their familiarization of their area of residence is highlighted both in the teacher's book as well as in the Curriculum of the subject of Geography and the Study of Environment of lower levels in the Primary School.

Research findings also pointed to the pupils' familiarization mainly with human-made features (the schools are located in an urban area), which is proven by the fact that children mentioned whatever elements they were familiar with mainly through their experiences. On the other hand, they seemed to be in trouble with estimating familiar distances and using of the north point to describe a location on map or aerial photograph.

Based on the research's findings, we now proceed to make the following suggestions hoping that students' abilities and geography teaching will be enhanced. What is primarily required is constant and systematic training for educators on the new Curricula, school textbooks and educational material and their disengagement from the traditional teaching methods are necessary. This should be coupled with appropriate activities, involving students using maps and aerial photographs more actively. The latter can be achieved when games and play roles are used, or when the subject of Geography is taught outside the classroom as field work.

With regard to the subject of geography, this should be assigned to educators who are subject-matter experts, so that knowledge and skills the students acquire are suitable and not limited merely to memorisation of sterile knowledge (Klonari and Koutsopoulos, 2005). Proper preparation of students for the subject of geography should start from the earlier levels, since, as many researchers reckon "…might mean that four – and five – year olds already have the cognitive basis to learn effectively about the nature of representations. If so, these age groups might benefit from appropriate education and be able to learn much more about maps and aerial photographs. … More extensive training might have had a greater effect on the children's performance." (Plester, Blades, Spencer, 2003: p.292).

More specifically, emphasis should be given to the development of students' distance perception and use of the north point, so they are able to describe positions on a map or an aerial photograph. Finally, the whole geography learning process should be supported by new state-of-the-art and appropriate school maps using symbols that do not cause misconceptions

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