Views of the islands: The geographical perception of the Balearic Islands among graduate students in primary education

Jaume Binimelis Sebastián
Department of Geography, University of the Balearic Islands, Spain
jaume.binimelis@uib.es (corresponding author)

Antoni Ordinas Garau
Department of Geography, University of the Balearic Islands, Spain
antoni.ordinas@uib.es

Maurici Ruiz Pérez
Department of Geography, University of the Balearic Islands, Spain
maurici.ruiz@uib.es

Abstract: Geographic literacy is a field of research with a great tradition. This area was first developed in the British and North American academic circles in the 1980s and 1990s, and research has continued until the present day. The analysis of perception and knowledge of geography has focused on the enclaves (toponyms) mentioned in the mental maps (place location knowledge) prepared by university undergraduate students of the primary education teaching major. However, this focus is also on an approach where few studies have been made, yet it has been facilitated by the incorporation of modern geographic information technologies. The authors test a methodology for surface area and perimeter size analysis on the mental maps of the Balearic Islands made by future teachers, comparing their distortions in relation to the real model. After analyzing the results, the most notable common pattern describing the insular students' perception of the isles is ethnocentrism, which undoubtedly has important implications in the field of geographic education.

Keywords: Balearic Islands, ethnocentricism, geography, islands, mental maps, perimeter, surface area

https://doi.org/10.24043/isj.400 • Received December 2021, Early access September 2022

Introduction

There is no tradition in Spain concerning the analysis of its citizens' geographical literacy, although there are similar conventions in other fields. This contrasts with customs in other environments, such as the United States, which has been assessing citizens' geographical literacy since the 1980s. In a lucid argument, Murphy (2018, p. 120) affirms that "familiarity with geography can open eyes to the richness and diversity of the world, contribute to the development of an informed citizenry and provide acute perceptions and visions of the present and possible futures." Hence, he carefully analyses surveys conducted by *National Geographic* in 2006, where 63% of young Americans claimed to be unaware of the location of Iraq, although the US had invaded the country three years earlier, and it continued to appear every day in the news (Murphy, 2018, p. 122). In short, the need to grasp the state of citizens' geographic knowledge and national interest in its improvement has a long history.

The curricula for a master's degree in primary education in Spain only surveys, in most universities, the subject of geography. On the other hand, it is easy to verify in the primary, ESO (*Educación Secundaria Obligatoria* [Compulsory Secondary Education]) and baccalaureate curricula a lack of cognitive and procedural contents linked to geographical knowledge, a chronic problem in the Spanish educational system. Buzo and Ibarra (2014), for instance, clearly describe the limited scope of geography in this system's cycle of compulsory secondary education (geography is present in the subject of social sciences in first and third grade) and in the baccalaureate (it is an elective second-year subject) and elaborate the interruptions in its teaching, which is limited to several courses without any option of continuity.

Therefore, Spanish students arrive at their university with a meagre academic background in geography. Future teachers, who will have the responsibility of initiating new generations in geographical science, are a conspicuous group. Regarding the social sciences curriculum of the LOMCE (*Ley Orgánica para la Mejora de la Calidad Educativa*) (Rodríguez-Doménech, 2015), recent research has tested for a minimum knowledge in geography using the content (territorial organization, enclaves, physical aspects) of mental maps (Binimelis & Ordinas, 2018). This approach has also been extended to other levels of the compulsory education system (Binimelis et al., 2021).

Accordingly, in this work, we analyze the geographical knowledge and perception of the Balearic Islands among future teachers in Spain by studying two of the geometric characteristics of mental maps: size and perimeter. In general, as shown in the following section, studies on geographic literacy that employ mental maps have focused their attention on map content (countries, regions and geographic enclaves) rather than map form and its multiple characteristics. In this case, when dealing with an archipelago, such formal aspects critically influence islanders' unique self-perceptions.

Cognitive geography and geographical literacy

In the 1960s a movement called the Geography of Perception was born and irregularly developed. Within this movement the authors have consistently argued for the subjective dimension of geography in relation to humans: a relationship between individuals and their territory that is of limited rationality and is stimulated by more than just economic factors. The individual outline or 'mental map' of the spatial perceptions of individuals (landmarks, paths and areas of a city, perceptions of the weather, location preferences) has been one of the tools most commonly used by researchers following this theory within geographic science. Generally, the geographer gathers a significant sample of individual mental maps of an individual nature to identify, after analysis, the patterns or common places of the participants in a cartographic survey (Gould & White, 1974, p. 53). Simultaneously, this humanistic geography with phenomenological roots has given rise to the development of a humanistic research path using qualitative methods (Boira et al., 1994).

Since the 1970s, cognitive geography (the current name for the antiquated geography of perception) has undergone a transition from a subdiscipline that analyses cognition (internal process) to one that evaluates the perception of space (action, external), to a distinct discipline that specifically focuses on spatial cognition (Portugali, 2018). Currently, knowledge and geographical reasoning are among the most important topics of cognitive geography. Thus, in this study, the mental map is used as a tool to evaluate the perception and geographical knowledge of students earning a Master's Degree in Primary Education at the University of the Balearic Islands.

The analysis of geographical knowledge is a technique with a long tradition, pioneered in Anglophone research field in the 1980s and 1990s, which has continued to the present day. It has been defined as the ability to understand, process and utilize geographic data (Turner & Leydon, 2012). However, in its most complex iteration, it requires students to have a critical understanding of the tools and skills to address, from a geographical perspective, problems, e.g., the exploitation of natural resources or inequalities between nations (Memisoglu, 2017). In its development, it has involved various methods and techniques that include sketch maps, i.e., mental maps, the ability to locate places (place location knowledge) and, finally, multiple criteria tests that include the identification of places along with other exercises in physical geography and human geography (Misheck et al., 2013).

The first detailed analysis of literacy in geography based on the use of mental maps was that of Saarinen (1987), which had a global dimension and scope. This project involved 3,568 geography students (first year) from 75 universities in 52 countries worldwide (Saarinen & MacCabe, 1995, p. 197). In the early 1980s, news media reported on the illiterate nature of Americans concerning the field of geography via various surveys that had highlighted it, driving Saarinen, a professor at the University of Tucson, to conduct this research (Saarinen & MacCabe, 1995, p. 196).

Also noteworthy due to their importance are articles by Patrick Wiegand, many of them collaborations with Bernardette Stiell, published in the United Kingdom. Wiegand

is specialist in the didactics of geography and in the use of cartography at different educational levels (Wiegand, 2006) and is exceptional for his reflections on geographic knowledge and perception in the UK among its future teachers of primary and secondary education and British school children (Wiegand & Stiell, 1996; 1997a; 1997b).

Several studies of great interest were published in the last decade. Global knowledge was the objective of several of these essays (Polonsky & Novotny, 2010; Nishimoto, 2012). Meanwhile, European scholars focused their attention on Hungarian (Rédep et al., 2012), Romanian (Bagoly-Simó et al., 2016), and Turkish (Sudas & Gokten, 2012) students. Currently, the *Meaningful Maps* project stands out based on its use of mental maps made by UK school children from 7 to 11 years of age to evaluate both their progress in obtaining cartographic skills and geographic knowledge and their sense of place, which reflects the affective aspects that determine the students' sketches the cultural reasons for them (Vujakovic et al., 2018). Furthermore, the mental map has recently been used by historians to study the political and social circumstances that have given rise to changing global perceptions during specific historical moments (Holmén, 2018).

Some existing results have been obtained in the field of geographic literacy with mental maps in Spain (Morales et al., 2013; Binimelis & Ordinas, 2018). However, to date, such studies have emphasized specific aspects of the content (place names) in the available maps of students earning a primary education degree. Therefore, research on the evaluation of geographical knowledge has focused on the analysis of the places that the authors of these maps have demonstrated that they know. However, it is also important to analyze the size of drawn surfaces as well as other components, such as the profile and other dimensions of a mental map. From this point of view, only a few contributions (e.g. Saarinen et al., 1996; Wiegand & Stiell, 1996; 1997a) have compared the maps that subjects imagine and draw with a reference model-reality.

Saarnien et al. (1996) used a planimeter to measure the surface of the continents of the planispheres drawn by the participating university students (quantifying the surface of the continents in 438 of the 3,568 recorded planispheres). Wiegand and Stiell (1996; 1997a) first studied the perceptions of 62 students regarding the size of the continents. They built a set of 5 cut-outs for each continent (1 correct, 2 oversized, 2 undersized). Their findings (oversizing of Australasia and Antarctica and undersizing North America, South America, and Africa) were linked to the cartographic culture students encountered in school (projections) and the influence of the media. This use of cut-outs was later replicated in a brief exercise in Greece (Filippakopoulou et al., 2003). Wiegand & Stiell (1997b) have also used a superimposed grid to count the grids and half grids of each part of the UK's political map. Both these artisanal methods, which require great effort, were used prior to the emergence of new information technologies and geographic information systems (GIS).

Wiegand and Stiell (1996, p. 66) challenge the scientific community to explore the continuity of this line of reflection by researching other latitudes. In addition, they foresaw how the emergence of new geographic information technologies would allow

the development of more grounded work via statistical data. The present paper has accepted this challenge, taking up this line of research while using GIS for its development.

Saarinen et al. (1996) concluded that the centuries-old persistence of the cartographic culture first imprinted by Mercator largely explains why many authors magnify the importance of Europe via so-called Eurocentrism, which has been repeatedly pointed out by many other authors (Rodríguez-Lestegás, 2019, p. 212). In their findings, Saarinen et al. (1996) effectively certify their support of this ethnocentric theory, whereby the size of the place of origin (in this case, a continent) is exaggerated. Wiegand and Stiell (1997b) thus evaluated Anglocentric maps because England is the most exaggerated political region in relation to its neighboring polities (Ireland, Wales, Scotland and Northern Ireland).

For Tuan (2007), ethnocentrism manifests in relation to the closest space to which we establish personal ties and is circumscribed to the local order of magnitude, denying that this characteristic can develop on a regional, national or continental scale. However, the examples of this Chinese-American author are often historical or are from societies with a precapitalist community organization. According to Tuan (2007, p. 50, p. 51), ethnocentrism is a generic human attribute, and the illusion of centrality and superiority is probably necessary to sustain culture. Nevertheless, he also states that topophilia rings false when it is proclaimed for a large territory; it requires a compact size, a limited scale that is determined by people's biological needs and sensory capacities (Tuan, 2007, p. 141): "The modern state is too large to know it personally, and its form is too artificial to be perceived as a natural unit." Ethnocentrism is thus closely linked to what Gould and White (1974, pp. 81-92) have called "local domes of preferences," e.g., in their answers about their preferred places to reside, British and American students prioritize the closest locales to their place of residence—a distorting effect of a more generic pattern.

The salient references discussed thus far highlight the validity of the mental map as a source of information for investigating the knowledge, perceptions and feelings (senses of place) that a territory generates among schoolchildren and students of differentiated environments. In this contribution to what is currently called cognitive geography, we thus exploit the mental map as a source of information to analyze the geographical knowledge and the perception that future teachers on the Balearic Islands have about their place of residence and/or origin (some students on the smaller islands reside in Palma, the capital of the community and the headquarters of the university). In addition, in contrast to most research in the field of geographic literacy, we focus on the shape of the mental map (size and perimeter) and map content in particular (names of places, enclaves and landmarks cited) (Binimelis & Ordinas, 2018). On the other hand, in the tradition of the extant studies, we introduce a novelty, the local scale (an archipelago of 4992 km^2, including five large islands), rather than the global, national or regional scales that are usually applied in the literature, which we employ only as unavoidable references (see Figure 1).

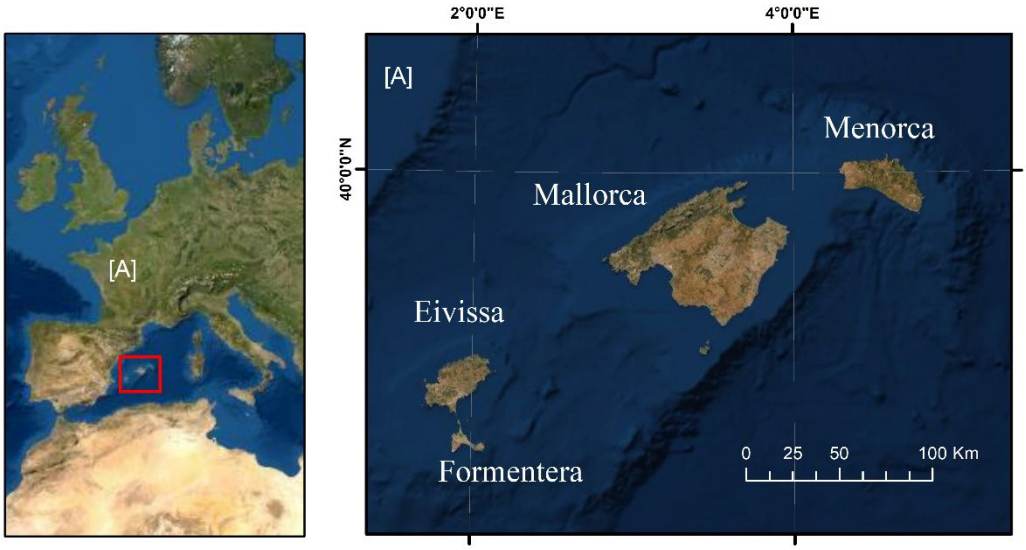

Figure 1. The location of the Balearic Islands.

Hypothesis and methodology

In this essay, we begin by hypothesizing that ethnocentrism presides as the ultimate reason for the deeper cognitive structure that insular students in primary education have regarding their lived space. Consequently, an educational system is somewhat of a veneer that covers the limited knowledge that formal education anchors via the lived experience of 12 years of compulsory and secondary education (Moreira, 1997).

Nevertheless, in this work, we analyze formal aspects of the mental map, which are also very important, i.e., we investigate the size of mental maps, their surface, in addition to their perimeter. That is, we delve into two geometric characteristics of the same map, regardless of the information provided by its author(s). Accordingly, we have followed a method and used tools that are different from those applied during the 1990s. Saarinen et al. (1996) used a planimeter, while Wiegand and Stiell (1997b) superimposed a transparent grid on each map to count the number of units occupied by every British political region. In both cases, a mental map was compared with reality (surface of the various continents or surface of the various British political regions) via relative numbers (percentage).

In principle, our study is similar, as we compare the relative data of the surface measurements of the five main islands of the Balearic archipelago (Mallorca, Menorca, Ibiza, Formentera and Cabrera) to the percentages of their real sizes. However, our method of obtaining data is radically different from those discussed above. The original maps were first scanned and then converted into PDF files that were transformed images (JPGs). These files were then uploaded into a GIS program (ArcMap version 10.5), which allowed us to calculate the area and perimeter of each of the islands in each of the maps. Finally, we created a database with the statistical information contained in DBF files for each of the projects (MDX files) that we created in ArcMap.

Using this final database, we obtained our results with the invaluable help of the statistical treatment program SPSS (*IBM SPSS Statistics 25*). Clearly, new technologies have allowed us to streamline our method. However, its first phase, requiring the digitization of maps over many hours of arduous work, had a very artisanal character. For data collection, we decided that the participating students would sketch their maps on DIN A-4 paper for approximately 30 minutes without any external information or cartographic reference, following the guidelines of the older studies.

Cluster analysis

The information matrix that relates each of the maps to the percentages that represent the relative size of the islands (five variables) and length of their perimeter (five other variables) facilitated hierarchical cluster analysis with the SPSS program (*IBM SPSS Statistics 25*), using the Ward method and the squared Euclidean distance as a parameter to measure the distance between the values of different individuals. Parallel factorial analysis of principal components was also performed, generating two factors that allowed us to graphically represent the clusters in a scatter plot (see Figure 5).

Taxonomical distance

We implemented the taxonomic distance method to obtain a final assessment of the degree of goodness concerning the relevance of the size and perimeter of the sketches to the actual dimension of the islands of the archipelago. In each case, we obtained the relative value of the weight of the surface and the perimeter for each of the islands, which function as variables (ten variables in total). Finally, each mental map provided five values for the surface and another five for the perimeter.

To obtain a single indicator that qualifies each map according to the adequacy of its size of the islands or its length of their perimeter to their real dimensions, we used taxonomic distance, integrating the combination index of Weaver cultures with this literacy exercise. The Weaver index was previously used to define the agricultural regions in the US Midwest according to the combination of crops that they grow (Castelló-Puig, 1984, p. 248). Practically, the Weaver index measures the degree of mismatch between a real and an ideal distribution. It has also been used to explore nonagricultural issues, such as the specializations of English industrial cities (Estébanez & Bradshaw, 1979).

Thus, in this study, we use the Weaver index to compare the distribution of the indicative values of the size (surface) and perimeter (distance) of the islands (Mallorca, Menorca, Ibiza, Formentera and Cabrera) with an ideal model of the size and actual perimeter of each of the five islands. Thus, we convert the absolute data into relative data (percentages) and apply the following formulation:

$$\mathbf{W = [\sum ((DI\text{-}DR)^{2})]/n}$$

Here, DI is the percentage of the ideal distribution, and DR is the percentage of the real distribution; n is the total number of islands (five major islands of the

archipelago). The obtained indicator therefore provides a map rating: the lowest values will be those of the most accurate maps, and the highest values will be those that are further from the ideal map, i.e., the real map.

This technique, with some variations, is largely based on the model that Jerzy Kostrowicky (1991) has used to define agricultural typologies.

Results

Reality versus representation

We analyzed 211 mental maps that were drawn by 47 male and 164 female students in the second year of their primary education degree during the 2016-2017 academic year. Not all students represented the set of the five main islands of the archipelago. The largest island was the most drawn, appearing in all the sketches we studied. It was even represented alone (five maps) or only accompanied by the nearest island, Cabrera (two maps). On the other hand, Cabrera, the smallest and only uninhabited island (currently a national park) was absent from 67 of the 211 maps we studied. On some occasions, were Menorca, Ibiza or Formentera were absent from the mental structure of the participating students (Menorca, 8; Ibiza, 8; Formentera, 13). The omnipresence of Mallorca on all the maps is a first indication of the dominant role of this island in the mental scheme of the Balearic student body. On the other hand, according to the average surface and perimeter values, Mallorca and, to a lesser extent, Formentera were oversized. In contrast, Menorca and Ibiza were, in general, underestimated by the students who participated in the study. Finally, the Cabrera sketches presented values with slight differences from reality. Although Cabrera does not appear on many maps, the weight of this island's measurements was not significant. Finally, the relevance of Formentera (only one student was from there) corresponded to the iconic image of the island worldwide.

Table 1. Comparison of the real data with the mean values of the mental maps. Own sources derived from the data provided by digitalization.

Surface area	**Mallorca**	**Menorca**	**Ibiza**	**Formentera**	**Cabrera**
Real distribution	72.76%	13.93%	11.43%	1.62%	0.26%
Mental map mean values	77.67%	11.03%	8.31%	2.63%	0.35%
Mean difference values	4.67%	-2.90%	-3.12%	1.01%	0.09%
Perimeter					
Real distribution	48.62%	23.38%	17.93%	6.17%	3.90%
Mental map mean value	56.52%	18.15%	14.15%	8.78%	2.40%
Mean difference values	7.90%	-5.23%	-3.78%	2.61%	-1.50%

Overall, the weight given to each island is related to the place of residence of the individuals who have made the maps. The students from Mallorca, for example, exaggerate the size and perimeter of their own island and deflate those of the islands

ranked second in order of magnitude, Menorca and Ibiza. Menorcan and Ibizan students, however, underestimate the largest of the Balearic Islands and magnify their own island's size and perimeter. However, Menorcan and Pitiusan students deflate the perimeter of Ibiza or Menorca, respectively. All the authors exaggerate the perimeter and surface of Formentera (only one student was Formenteran). Cabrera's size is exaggerated by Mallorcan students and to a lesser extent Menorcan students, while the Pitiusan students underestimate its surface area, and all three groups deflate Cabrera's perimeter. It is the least-familiar island (it does not appear on 67 maps); therefore, it has extreme values. In any case, Cabrera can be considered a known island, especially among the Mallorcans (see Table 2).

Table 2. Distribution of the mean values obtained for each island according to the origin of the map authors. Own sources derived from the data provided by digitalization.

Surface area/Origin	**Mallorca**	**Menorca**	**Ibiza**	**Formentera**	**Cabrera**
Mallorca	80.47%	10.10%	6.91%	2.15%	0.36%
Menorca	65.81%	17.25%	12.22%	4.43%	0.29%
Pitiusas	58.72%	14.65%	20.24%	6.17%	0.22%
Real dimensions	72.76%	13.93%	11.43%	1.62%	0.26%
Perimeter/Origin					
Mallorca	58.94%	17.39%	13.17%	7.98%	2.52%
Menorca	45.27%	24.93%	16.84%	10.92%	2.04%
Pitiusas	41.27%	19.04%	22.53%	15.78%	1.39%
Real dimensions	48.62%	23.38%	17.93%	6.17%	3.90%

Hence, there is a slight tendency to overvalue one's native island (Mallorcacentrism is rather significant) and to underestimate the measurements of the rest, with the exception of Formentera and, to a lesser extent, Cabrera.

The classification of mental maps

The digitized mental maps (the surface and perimeter, in relative data, of each of the five main islands) provide extensive information (211 maps x 10 variables), which we have synthesized and classified. Accordingly, we have performed hierarchical cluster analysis to identify three clusters. We have also reduced the variables with principal component factor analysis to obtain two factors (which explain 69.6% of the total variance).

The first factor is defined by the controversy between the largest of the islands, Mallorca (with a high negative weight in both parameters, surface area and perimeter), and the smaller islands with very high positive weights (Menorca, Ibiza and Formentera). We therefore define it as Mallorca versus smaller islands. Meanwhile, Cabrera remains on the side-line, with an insignificant negative value for both indicators (surface area and perimeter). The second factor, however, is defined by the weight of Cabrera and by the insignificance of the other variables (see Table 3).

Table 3. Factorial component matrix. Own sources derived from the data provided by digitalization.

Variables/Factors	Mallorca versus the Smaller Islands	Cabrera
Mallorca (SA)	-0.972	-0.034
Menorca (SA)	0.798	-0.052
Ibiza (SA)	0.812	0.097
Formentera (SA)	0.572	-0.096
Cabrera (SA)	-0.041	0.946
Mallorca (P)	-0.956	-0.145
Menorca (P)	0.708	-0.081
Ibiza (P)	0.779	0.021
Formentera (P)	0.728	-0.054
Cabrera (P)	-0.038	0.943

Where SA = surface area, P = perimeter

Thus, the cluster analysis delineated three groups comprising 93 maps (Group 1), 111 maps (Group 2), and 7 maps (Group 3). Clusters 1 and 2 are those that polarize the confrontation between Mallorca and the smaller islands. Between all others and polarized at one extreme (high values of Factor 1) are the maps of the students from Menorca and Pitiusas, where these islands are exaggerated in relation to Mallorca (see Map 21015, Figures 2 and 3). However, in general, Group 1 consists of the maps that achieve a greater balance in their proportions, giving importance to the weight of the smaller islands (see Map 11035, Figures 2 and 3). The maps that are part of Cluster 2 exaggerate the surface and perimeter of Mallorca, which is this cluster's main characteristic. It is, therefore, the group that is characterized by a marked Mallorcacentric bias (see Figures 2 and 3, Map 12003). Cluster 3 includes a limited number of maps whose common characteristic is their reduction of the archipelago to a single island, Mallorca, sometimes accompanied by Cabrera. Hence, this group offers an even more extreme view (in relation to Cluster 2) of an archipelago that is dominated by its largest island, Mallorca (see Figures 2 and 3, Map 13038).

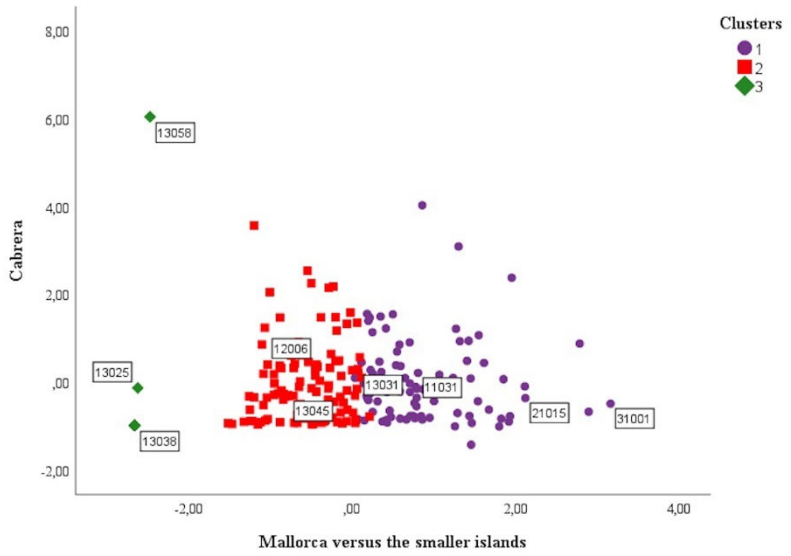

Figure 2. Mental map classification into clusters according to surface area and perimeter.

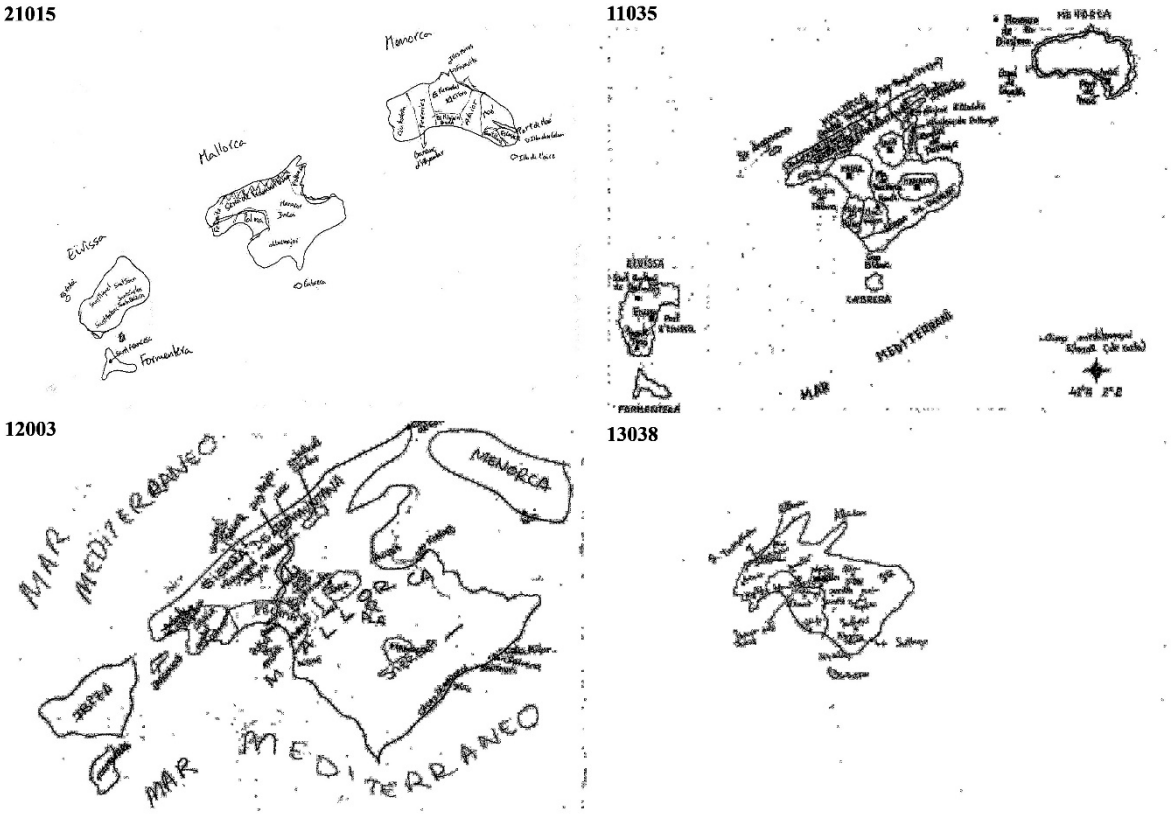

Figure 3. Examples of the mental maps according to their cluster.

Taxonomic distance and the grouping of maps according to their balance of proportions
The taxonomic index allowed us to compare the dimensions (surface and perimeter) of the islands on the mental maps with their real dimensions and to reduce everything to a single parameter. The values of the index that approach 0 are those that are closest

to the real proportions. We obtained a surface index and a perimeter index. Both variables are asymmetric, that is, their distribution of values is not normal (Kolmorov-Smirnov test with statistical significance p <0.001). Additionally, there was a positive correlation between them (Spearman's RHO correlation coefficient: 0.804; with statistical significance since p <0.001), demonstrating that both geometric parameters are intimately related and, in general, that a proportionate surface is accompanied by a proportionate perimeter.

On the other hand, both taxonomic distances allowed us to classify the maps according to the quality that they expressed in their proportions of size and perimeter. A scatter diagram thus allowed us to establish four categories of maps by considering the median of both distributions (the median is used because both are asymmetric, not normal, distributions) (see Figure 4 and Table 4).

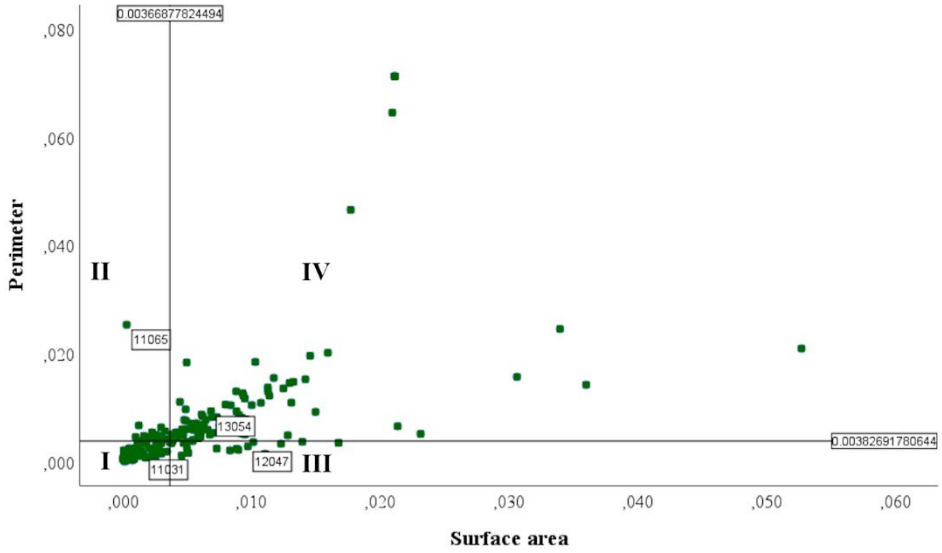

Figure 4. Mental map dispersion and classification according to the values of surface area index and the perimeter index.

Table 4. Mental map classification according to the values of the surface area index and perimeter index. Own sources derived from the data provided by digitalization.

Map classification according to the value of taxonomic distance	**Number**
I. Proportionate surface area and perimeter	88
II. Proportionate surface area and disproportionate perimeter	18
III. Disproportionate surface area and proportionate perimeter	18
IV. Disproportionate surface area and perimeter	87
TOTAL	211

The first group of maps (88 maps of the total) is characterized by proportions, in surface and perimeter, equal to those of reality (See Map 12047, Figure 5). The second group of maps is defined by a surface index that is close to the real proportionality but

with a perimeter index that is further from it (see Map 11031, Figure 5). Third, another minority grouping is formed by those maps that offer a mismatch in the size of the islands, although they better reflect the islands' perimeter (see Map 13054, Figure 5). Finally, a large group of sketches are clearly unadjusted in surface and perimeter (See Map 11065, Figure 8). Overall, proximity or distance to reality, a criterion often used for this type of classification, are not used. Specifically, rather than focusing on the profile of the maps, i.e., the cartographic quality of each drawing, we evaluate two geometric qualities—the islands' size and the length of their perimeter—by quantifying and comparing them.

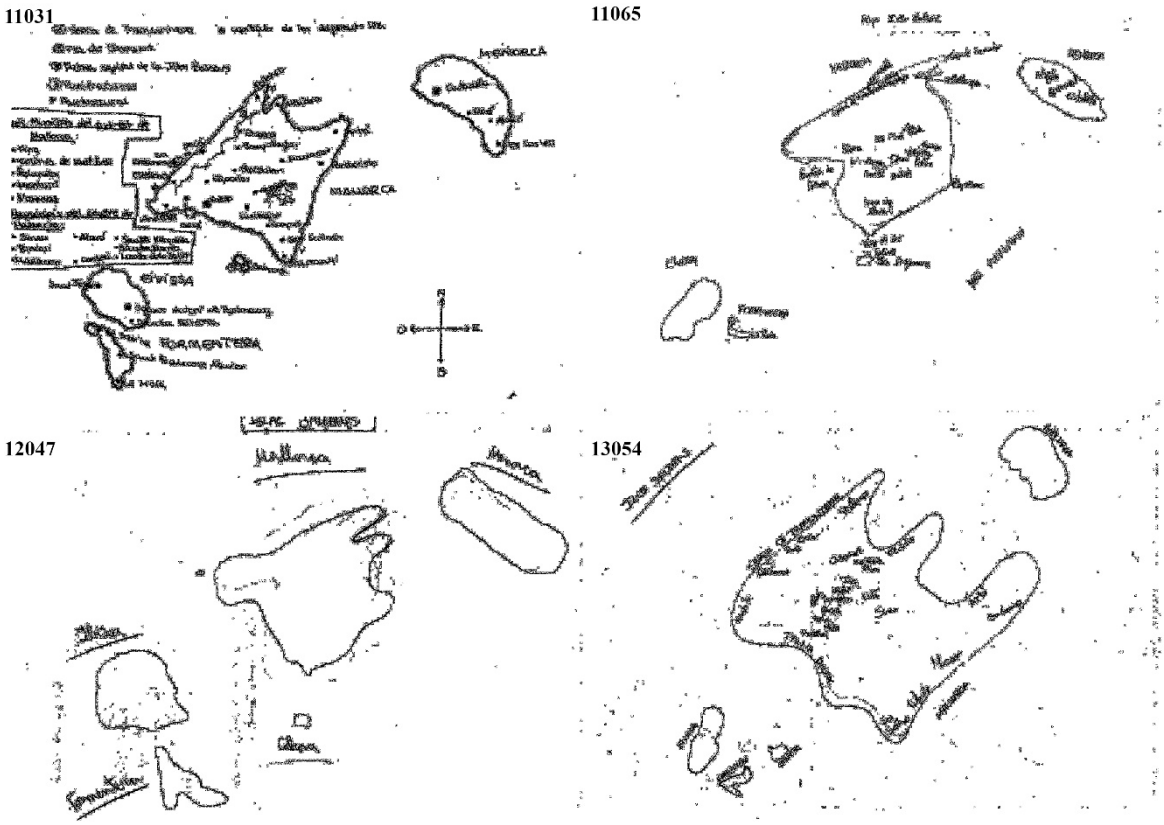

Figure 5. Mental map examples according to their surface area index and perimeter index values.

Is provenance related to the results of the surface and perimeter taxonomic indices?
The various results we have obtained clearly show that ethnocentrism is a latent characteristic of the analyzed maps. This is manifested in a Mallorcacentric way, as this is the largest island and the origin of the majority of the participants. However, there are subgroups of maps that are characterized by the overvaluation of the size and perimeter of the smaller islands, which is manifested above all on the group of maps made by students from Menorca or Pitiusas. Accordingly, we have logically sought to determine the relationship between the origin of the participating students and the results of the surface area and perimeter surface indices.

Table 5. Surface area index and perimeter index mean values according to origin. Own sources derived from the data provided by digitalization.

	Surface Index	Perimeter Index
Mallorca	0.00513	0.00748
Menorca	0.00648	0.00339
Pitiusas	0.01149	0.00620
TOTAL	0.00570	0.00704

The means for each index have a differentiated behavior according to student origin (see Table 5). For Pitiusas, the maps obtain the highest average and are therefore the furthest from reality. Ranked second is the mean of the cartography prepared by the students from Menorca, and the average of the maps of the Mallorcan students is the closest to reality. Regarding perimeter, the students from Mallorca obtained a mean that is furthest from the real model, and the average of the maps made by the Pitiusas students ranked second. Finally, the set of maps drawn by the students from Menorca achieved a lower average. Therefore, these means highlight the differences between the distributions of values of each group according to their origin. The Kruskal-Wallis test, where we relate the distribution of values of the surface and perimeter indices with the origin of the participants, thus allows us to reject the null hypothesis, i.e., that the distribution of values in each category should be the same. The Kruskal-Wallis test confirms that there is a relationship between the origin of the students (Mallorca, Menorca and Pitiusas) and the values obtained in the surface and perimeter indices (statistical significance $p = 0.040$ in the first case and $p = 0.0067$ in the second case; therefore, $p < 0$). That is, the origin of the students is related to our findings in the taxonomic indices of the surface and distance of their mental maps.

Discussion

This essay deepens a thematic area for which some relevant articles have already been published and others are currently in press. In short, the geographic literacy of future primary education teachers (Binimelis & Ordinas, 2018) and that of students who complete primary education (Binimelis et al., 2021) have been investigated. Therefore, we can observe a crossroads between a recurring theme, minimum knowledge of geography, and the use of mental maps, a source of information that has been used since the emergence of what is called cognitive geography, as an instrument for this theme's investigation. Hence, a field of study has been revived—geographical literacy with mental maps—which had its most critical moment in the Anglophone world from the late 1980s (Saarinen, 1987) to the late 1990s (Saarinen & Maccabe, 1995; Saarinen et al., 1996; Wiegand & Stiell, 1997a; 1997b) and has persisted until today (Vujakovic et al., 2018).

However, thus far, research in the field of geographic literacy has been limited to analysis of the place names labelled in the cartography that was carried out by students participating in minimum knowledge tests. In contrast, the current study exercise deepens such analysis by evaluating the drawings or sketches per se. Thus, two

geometric indicators of mental mapping are measured and studied: the size and length of the perimeters of the Balearic Islands. Undoubtedly, new geographic information technologies have facilitated the processing of information, an incredible innovation that the pioneers of this type of exercise did not possess (Filippakopoulou et al., 2003; Saarinen et al., 1996; Wiegand & Stiell, 1996; 1997a; 1997b). Nevertheless, despite the use of automatic cartography packages (digitalization of mental maps with *Arc Map 10.5*), obtaining quantifiable information has not ceased to be an arduous task. However, we suggest that our findings contribute to reviving the debate on ethnocentrism or to reactivating the reflection on geographic literacy by seeking new formulas for its analysis.

As we have already explained, the magnification of the environment itself, together with the simplification of the unknown and the foreign, is an intrinsic characteristic of human societies. Tuan (2007) first defined this as ethnocentrism. Geographers who dedicated a large part of their efforts to geographic literacy called it Eurocentrism (Saarinen et al., 1996) when they studied mental maps of the world or Anglocentrism in regional (the British Islands) research (Wiegand and Stiell, 1997b). The ethnocentrism of such mental maps was linked to the "local domes of preferences" identified by Gould and White (1974, pp. 81-92). However, there are large differences in this approach and ours in terms of the nature of the information (places preferred by the respondents vs. formal indicators of the cartographic sketches), the method used and, above all, the order of magnitude (the UK or the US vs an island region of 4992 km^2).

Thus, this article constitutes a significant advance, confirming that ethnocentrism manifests not only on a global or regional (state) scale but also on a local scale. Specifically, we show that Mallorcacentrism is characteristic of a large part of the analyzed maps. However, we have also found subgroups of maps that magnified the smaller islands (Menorca or Ibiza and Formentera) in a fashion that generally coincided with the maps made by students from those islands. Therefore, the origin of the participating students is related to the type of map they produced; hence the Mallorcacentrism or ethnocentrism of the smaller islands is linked to the students' place of habitual residence. On the other hand, recent studies have demonstrated that the island university students' perceptions of Spain is different from that of the peninsular university students, hence the ethnocentric vision, which has been emphasized in this contribution, is persisting (García-González et al., 2021).

We have transposed the so-called Weaver Index (Castelló-Puig, 1984; Estébanez & Bradshaw, 1979), a method for the classification and definition of the characteristic crops of a region, to our analysis of the size and length of the perimeter of the islands of the Balearic Archipelago. This method facilitated a comparison of the distribution of the relative values (%) for size and perimeter of the five islands that form the Balearic Archipelago with the real model. Any map that obtained the lowest numerical result was the map closest to the real distribution of values and, therefore, the most proportionate map. Accordingly, we have created an innovation through this discovery of methodologies that allow the measurement of geographic literacy in its different facets.

Conclusions

This contribution constitutes an advance in the field of geographic knowledge research, based on the analysis of mental maps. In general, this type of exercise has insisted on the study of the places cited (place location knowledge) and their location—and, therefore, on the locational knowledge of place names in any demonstration of the knowledge retained in the individual memory of the authors of the maps. However, this work analyses two formal variables of the cartographic sketches of the Balearic Archipelago, i.e., the size of the islands and the length of their perimeters.

The quantification of both parameters has been achieved with the digitization of the cartographic sketches (digitization of the mental maps with ARCGIS), which constitutes a new way of obtaining measurements of the shapes of these sketches that is very far from the known artisanal methods of pioneering studies on the subject. Undoubtedly, the use of GIS has allowed the development of this research. Its use facilitates such analysis, although it also requires a previous phase of arduous craft, the only means to obtain the necessary data for its subsequent execution.

On the other hand, the great utility of taxonomic distance as a method for classifying and evaluating cartographic sketches has been tested. This method (based on a methodology widely used in the field of rural geography) has facilitated ordering, classifying and evaluating the rigor of mental maps via two of their formal parameters.

Nevertheless, this research remains incomplete, as other novel indicators of geometric parameters of insular mental mapping, such as the profile and the distances between the islands that make up the archipelago, have not been investigated. All these scientific challenges are part of a larger investigation, which aims to verify that locational knowledge demonstrates not only the geographical knowledge of the authors of mental maps but also the formal aspects of their sketches.

In this essay, we have shown that in a local order of magnitude (Balearic Islands) in an urbanized tourist region, university students magnify, in general, their own island and, above all, the largest island of the archipelago. The oversizing of the island itself (according to the author's origin) manifests the formal aspects of the outline, i.e., what has been called ethnocentrism (Mallorcacentrism in our case): this is the main finding of the work. The origin of the students is related to the goodness of fit in the result of their maps' taxonomic indices of size and perimeter. Therefore, the balance or mismatch of proportions of the different maps varies according to the origins of the students participating in this test.

In addition to the Mallorcacentrism and the magnification of Menorca and Ibiza among the students from those islands, we have produced findings with lesser significance, which are more localized and not part of any universal pattern. Hence, we must mention the magnification of Formentera, an extended pattern on most maps. Undoubtedly, Formentera has become a global icon since the 1960s and has even been present in films and advertisements in recent decades. On the other hand, Cabrera, a national park since 1991 with an incredibly attractive great natural and cultural heritage, is the least familiar of the five main islands of the archipelago.

Ethnocentrism as a generic pattern, whether of a Mallorcacentric nature or the result of the oversizing of some of the smaller islands, manifests the weight of the closest environment, again, among the participants in this test, university students. This is an atavistic pattern that is usually found in the sketches of precapitalist societies, but we have shown that it also informs the actuality of the cartographic work of university students in a touristic, service-oriented and urbanized society, the Balearic Islands. Hence, there are deep structures with great power that are involved in the training of skills and the acquisition of knowledge during 12 years of primary and secondary education. It is evident that the Spanish educational system, in its teaching of geography, suffers from, among other things, an inability to link the acquisition of academic knowledge with the experiences students acquire in their daily work, the basis of all meaningful learning.

References

Bagoly-Simó, P., Dulama, M.E., Oana-Ramona, I., Sorin-Alin, K., & Bianca Sorina, R. (2016). Exploring map drawing skills of geography teacher training students. *European Proceedings of Social and Behavioral Sciences*, 12, 41-47.

Binimelis, J., & Ordinas, A. (2018). Alfabetización en Geografía y mapas mentales. Los conocimientos mínimos entre los estudiantes universitarios de Educación Primaria, *Cuadernos Geográficos*, 57(1), 330-351. https://doi.org/10.30827/cuadgeo.v57i1.5528

Binimelis, J., Ordinas, A., & Ruiz, M. (2021). Assessing geography knowledge in primary education with mental map analysis: a Balearic Islands case study, *Educational Studies*. Epub ahead of print. https://doi.org/10.1080/03055698.2021.1922877

Boira, J.S., Reques, P., & Souto, X.M. (1994). *Espacio subjetivo y geografía: orientación teórica y praxis didáctica*. Nau llibres.

Buzo, I., & Ibarra, P. (2014). La posición de la Geografía en la Educación Secundaria y el Bachillerato. Informe inédito. AGE. http://ciug.gal/PDF/informeage13.pdf

Castelló-Puig, A. (1984). Los usos del suelo en la comarca de Monegros. Argensola: *Revista de Ciencias Sociales del Instituto de Estudios Altoaragoneses*, 98, 231-268. https://doi.org/10.18682/jcs.vi14.2040

Estébanez, J. E., & Bradshaw, R. P. (1979). *Técnicas de cuantificación en Geografía*. Tebar Flores.

Filippakopoulou, V., Michaelidou, E., & Nakos, B. (2003). Spatial knowledge acquisition in children of different cultures. In *Proceedings of 21st International Cartographic Conferenc*e, Durban, South Africa, (pp. 10-16).

García-González, J.A., Gómez-Gonçalves, A., Gómez-Trigueros, I.M., & Binimelis-Sebastián, J.(2021). Geographic literacy in Spain with mental maps. *Journal of Geography in Higher Education*. https://doi.org/10.1080/03098265.2021.2001643

Gould, P., & White, R. (1974). *Mental Maps*. Penguin.

Holmén, J. (2018). Changing mental maps of the Baltic Sea and Mediterranean regions. *Journal of Cultural Geography*, 35(2), 230-250. https://doi.org/10.1080/08873631.2017.1401405

Kostrowicki, J., & Szyrmer, J. H. (1991). *Agricultural typology guidelines*.

Memisoglu, H. (2017). Opinions of Teachers and Preservice Teachers of Social Studies on Geo-Literacy. *Educational Research and Reviews*, 12(19), 967-979. https://doi.org/10.5897/err2017.3315

Misheck M., Ezra P., & Mandoga, E. (2013). Geographic Literacy and World Knowledge amongst Open Distance Learning Students in Zimbabwe. *Greener Journal of Educational Research*, 3(7), 301-309. https://doi.org/10.15580/gjer.2013.7.051413612

Morales, A. J., Caurín, C., & Souto, X. M. (2015). Percepción del mundo: mapas mentales y problemas socioambientales. *Didáctica Geográfica*, (14), 91-108.

Moreira, M. A. (1997). Aprendizaje significativo: un concepto subyacente. In M.A., Moreira, M.C., Caballero, & M.L. Rodríguez (Coord.), *Actas del encuentro internacional sobre el aprendizaje significativo* (pp. 44-68). Servicio de Publicaciones de la Universidad de Burgos.

Murphy, A. (2018). *Geografía ¿Por qué importa?* Alianza Editorial.

Nishimoto, S. (2012). Evaluating mental maps. [Unpublished master's thesis]. University of Oregon.

Polonský, F., & Novotný, J. (2010). Cognitive Mapping of Major World Regions among Czech Geography Students. *Journal of Maps*, 2010, 311-318. https://doi.org/10.4113/jom.2010.1083

Portugali, J. (2018). History and theoretical perspectives of behavioral and cognitive geography. In D. R. Montello (Ed.), *Handbook of behavioral and cognitive geography* (pp. 16-38). Edward Elgar Publishing. https://doi.org/10.4337/9781784717544.00007

Rédep, M., Kincses, Á., & Jakobi, Á. (2012). The World seen by Hungarian students: a mental map analysis. *Hungarian Geographical Bulletin*, 60(2), 135-159.

Rodríguez-Lestegás, F. (2019). Pensar el espacio para educar geográficamente: La intencionalidad del lenguaje cartográfico. En X.C. Macía, F.X. Armas, & F. Rodríguez (Coord.). *La reconfiguración del medio rural en la sociedad de la información. Nuevos desafíos en la educación geográfica*. (pp. 201-225). Andavira Editora. https://doi.org/10.2307/j.ctv20hctkf.7

Rodríguez-Doménech, M. A. (2015). La geografía en la LOMCE ¿una ocasión perdida? *Boletín De La Asociación De Geógrafos Españoles*, (67). https://doi.org/10.21138/bage.1831

Saarinen, T. F. (1987). Centering of mental maps of the world (Paper series 87-7). Department of Geography and Regional Studies. University of Arizona.

Saarinen, T. F., & Maccabe, C. L. (1995). World patterns of geographic literacy based on sketch map quality. *Professional Geographer*, 47(2), 196-204. https://doi.org/10.1111/j.0033-0124.1995.00196.x

Saarinen, T., Parton, M., & Billberg, R. (1996). Relative size of continents on world sketch maps. *Cartographica: The International Journal for Geographic Information and Geovisualization*, 33(2), 37-48. https://doi.org/10.3138/f981-783n-123m-446r

Turner S., & Leydon J. (2012) Improving Geographic Literacy among First-Year Undergraduate Students: Testing the Effectiveness of Online Quizzes, *Journal of Geography*, 111(2), 54-66. https://doi.org/10.1080/00221341.2011.583263

Sudas, I., & Gokten, C. (2012). Cognitive maps of Europe: Geographical Knowledge of Turskish Geography Students. *European Journal of Geography*, 3 (1), 41-56.

Tuan, Y. F. (2007). *Topofilia*. Ed. Melusina.

Vujakovic, P., Owens, P., & Scoffham, S. (2018). Meaningful Maps: What can we learn about 'sense of place' from maps produced by children? *Society of Cartographers Bulletin*, 51, 9-19.

Wiegand, P. (2006). *Learning and teaching with maps*. Routledge.

Wiegand, P., & Stiell, B. (1997a) Mapping the place knowledge of teachers in training, *Journal of Geography in Higher Education*, 21(2), 187-198. https://doi.org/10.1080/03098269708725424

Wiegand, P., & Stiell, B. (1997b). The development of children's sketch maps of the British Isles. *The Cartographic Journal*, 34(1), 13-21. https://doi.org/10.1179/caj.1997.34.1.13

Wiegand, P., & Stiell, B. (1996). Children's estimations of the sizes of the continents. *Educational Studies*, 22 (1), 57-68.