



## GEOGRAPHIC LITERACY IN THIRD-YEAR COMPULSORY SECONDARY EDUCATION STUDENTS

**Abstract.** *Poor geographic knowledge among students and citizens, in general, has been one of the main research concerns in the area of geography education.*

*This study is part of a project aimed at determining compulsory secondary education students' level of geographic knowledge and providing tools to improve learning. Following quantitative research methods, the geographic knowledge and competences of the participating students have been assessed through an online test. Additionally, the circumstances associated with the students' personal and academic environment that contribute to explaining the results have been established. The findings show the participating students' scarcity of geographic knowledge, both regarding specific curricular contents and spatial competence. The results obtained suggest the pressing need to find a new geography teaching approach that is more clearly linked to the language of maps.*

**Keywords:** *geographic literacy, geographic knowledge, online map editor instrument, place location knowledge, pre-test data evaluation*

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### Introduction

The scarcity of geographic knowledge and spatial competence of students and society at large should be a priority issue for geographers, scholars, and researchers in geography education, as well as for decision-makers and agents in the area of education. Despite the wealth of available resources for citizens to consolidate a high level of geographic knowledge so that they can understand today's world, many who live in the global age still have a completely outdated perception (McFarlane, 2024). Geographic literacy is the ability to think in terms of terrestrial systems and their interconnections with the ultimate goal of facilitating everyday decision-making, which includes choosing a certain dwelling place or what precautions to take against natural hazards associated with specific areas (Edelson, 2011). Concern about poor levels of geographical knowledge and skills is also noticeable in the suggestions that are made to researchers in geography teaching, who are urged to subject students to routine tests to monitor their learning progress (Bednarz et al. 2013).

Geographic ignorance is not only common among citizens and students of different educational levels but also among those who, holding pre-eminent positions in the academic field, are devoted to studying the world, making basic mistakes in their analyses (Lewis, 2000). Morgan (2017) believes that the root cause of such ignorance lies in the influence of several factors that have affected geography as a discipline since the 1950s and 1970s. First, the quantitative revolution pushed aside old descriptive content. Meanwhile, as a result of the pedagogical shift, geography teaching became dependent on education rather than on geography departments; therefore, in the late 1990s, the focus shifted from content to how to teach it. All this was reinforced by the influence of postmodernism, whose critical currents regard knowledge as a social product, therefore invalidating the status of certain geography contents as fundamental. Such critical currents advocate the redefinition of what we know as geographic literacy. According to Morin (2013), the theory about the population's lack of geographical knowledge is based on a very classical, descriptive view of geography. Moreover, he states that its advocates are part of a conglomerate of interests, whose participants



include universities, large companies such as the Environmental Research Institute, Inc. (ESRI), and even the powerful U.S. military industry. In short, in the 1970s, the study of geography at school set out on a long path that has driven it away from content (Morgan, 2017).

This situation has raised considerable concern about the geographical knowledge of both citizens and the academic world (Lewis, 2000). Because of this, research on geographic literacy, understood as the ability to understand, process and use geographical data (Turner & Leydon, 2012) has proliferated since the 1980s (McFarlane, 2024). The studies not only include place location knowledge (henceforth PLK) but also differentiated facets of knowledge.

Current society's scant knowledge of the world that we live in also worries geographers and geography education specialists in Spain, who attribute such lack of geographic and spatial competences among citizens to the poor recognition that this science is given in the education system and, therefore, in the training of future teachers (De Miguel, 2018, 2022). This holds a slight similarity with American ethnocentrism, which undervalues other peoples and cultures; thus, the lack of geography contents and subjects in the official curriculum, relegated to the background to prioritize market needs, has contributed to the growing view of geography as irrelevant in the United States (McFarlane, 2024).

Studies on geographic literacy include differentiated aspects of such knowledge that go beyond PLK. On the other hand, studies on PLK have followed up to three paths of development (Torrens, 2001). Firstly, they are part of broader research on geographic literacy where location knowledge plays a minor role, as is the case with the *InterGeo Project* used by Ireland in the 1990s (Waddington & Shimura, 2019). More recently, in the United States, the American Association of Geographers conducted a survey among older adults on the subject of geography knowledge and values. In this study, geographic literacy is regarded as a broader concept than merely place location (Kozak et al., 2015). On other occasions, surveys have approached more specific topics such as climate change in countries where forecasts predict that it will be severe (García et al., 2022). In the second place are cognitive studies where mental maps or cartographic sketches are used as tools to analyze geographical knowledge. This is a long-established line of work, especially approached in the United States and the United Kingdom in the 1980s and 1990s (Saarinen, 1987; Saarinen & Maccabe, 1995; Wiegand, 1998; Wiegand & Stiell, 1997), but also followed in recent years (Hagge, 2023a; Nishimoto, 2012). Thirdly, PLK has been studied through specific tests using blank maps where users were required to label and identify the characteristics of certain places (Hagge, 2023b; Torrens, 2001). Other authors compare the consolidated knowledge of schoolchildren from Sweden and Australia using up to three tools: mental maps, a list of known places, and another list of countries that are liked or disliked (Reynolds & Vintereck, 2016). In an outstanding state of the question, Scoffham (2019) echoed this entire discussion and, focusing on school students, analyzed the places they know, how they know them, the factors relevant to such knowledge and how they feel towards them. In short, the geographic knowledge acquired by students at different levels of the education system has always deserved the attention of researchers in the area of geography education.

Despite researchers' ongoing work in assessing the geographic knowledge of young students, university students, and citizens, there are still important challenges, some of which this study attempts to address. This research shows the general results of the pre-test carried out in the framework of a broader project that delves into the geographic knowledge of third-year compulsory secondary education students (Project for the Generation of Knowledge: *Geographic Knowledge of Spain, Europe, and the World among Compulsory Secondary Education Students*, Project PID2021-124390OB-I00). The mentioned project's second phase aims to develop an educational intervention based on active geography learning methodologies that are clearly linked to the language of maps to build geographic knowledge related to the most basic spatial and geographic competences. Over the last years, the research team in charge of the project has been working on the geographic knowledge of future teachers (Binimelis-Sebastián et al., 2023a) and primary education students (Binimelis-Sebastián et al., 2023b), from the angle of cognitive geography. This study is the first delivery of a work of research that approaches new challenges, this time focusing on compulsory secondary education students, whose geographic knowledge relies on memory-based geography (De Miguel, 2013). The project pursues to break this inertia and lay the foundations to define how geography should be taught in Spain's secondary education centers to improve citizens' geographic knowledge so that they can interpret the challenges of the world they live in. This study is, in essence, the partial result of the first stage of a more ambitious project that not only addresses the topic of the geographic knowledge of compulsory secondary education students (conceptual and PLK) but also seeks ways to improve it. On the other hand, as regards methodology, this research opens a new path for the assessment of students' geographic knowledge by using an online test that, in turn, makes it possible to link conceptual geographic knowledge to correctly locating places on a map (PLK) using an automated data collection instrument.



In short, this study is part of a research project that takes on both challenges: the first, whose nature is educational, is addressed using active methodologies to find ways to improve students' geographic knowledge and spatial competence; and the second, which is technological and methodological in nature, is addressed through the use of a novel instrument for the automated collection of data regarding the correct location of places (PLK).

The purpose of this study was to examine the global results obtained from the pre-test conducted in October 2023. The exercise was part of a broader research project aimed at shedding light on how to improve the geographic knowledge and spatial competences of compulsory secondary education students. It is also the touchstone as regards the use of the geographic data gathering online instrument designed for the development of this work. The instrument has revealed the geographic knowledge and spatial competence of third-year compulsory secondary education students, according to the current Spanish curriculum. This study provided the answers to the following three research questions (RQ):

RQ1: Is the knowledge of the geography curriculum (concepts) and the PLK compulsory secondary education students poor?

RQ2: Is there a relation between compulsory secondary education's curricular geography knowledge (concepts) and PLK (spatial competence)?

RQ3: Do compulsory secondary education students' personal circumstances (gender, education, habits and customs) have an influence on their curricular knowledge and PLK?

## Research Methodology

### *General Background*

In this study, a correlational research design (Pearson's correlation coefficient), Student's t-test for independent samples, and one-way analysis of variance (ANOVA) were used, following a quantitative approach (Clifford et al., 2016). For data collection, an instrument that is, at the same time, a test to determine the level of geographic knowledge and cartographic-spatial skills of the participating students and an online map editor tool was designed. The data were gathered in October 2023 from 8 compulsory secondary education centers (4 pilot and 4 experimental centers) in the Balearic Islands (Spain). The statistical methods used have confirmed whether or not there are relations between variables corresponding to the students' personal environments (socio-economic, gender, use of new technologies, acquired habits such as journeys made), defined as independent variables, and the test results (determined geographic knowledge), regarded as the dependent variable. The reason for using different techniques is based on the type of each independent variable (categorical, dichotomous, or numeric). These statistical measures were used to determine the linkage between variables. The study shows the results of the pre-test of a project that is framed in a line of research that analyzes the condition of compulsory secondary education students' geography knowledge through their personal geographies from the angle of the didactics of geography.

### *Sample*

The participating students were selected through non-probability sampling, which is a non-random process. In convenience sampling, which is the most commonly used in the area of education, teachers select their students to participate in the research process (Cohen et al., 2003).

The test was taken by a total of 275 third-year compulsory secondary education students from eight compulsory secondary education schools in the Balearic Islands, four control centers (116 students) and four pilot centers (159 students), who, on a voluntary basis, wanted to participate in this experience. Regarding gender distribution, the pre-test was taken by 140 boys (50.1%), 127 girls (46.2%) and 8 individuals who described themselves as non-binary (2.9%) (see Table 1). The reason for using four secondary education centers as pilot centers is because there are four secondary education teachers in the research project's team whose research is linked to the university and who are in charge of didactic experimentation (second phase of the project) in their centers. The educational intervention was carried out in the spring of 2024, involving more than 15 sessions. Hence, the logistic arrangements for the development of the intervention made it impossible to increase the number of participants in the diagnosis and assessment phases.

**Table 1**  
*Participating Students According to Gender and Type of Center*

Type of center	Boys	Girls	Nonbinary
Control centers	55	54	7
Pilot centers	85	73	1
Total	140	127	8

*Instrument and Procedures*

The test is the result of a long process throughout which numerous meetings were held among members of the research team and of the work team (made up of compulsory secondary education in-service geography and history teachers), forming a discussion team that was moderated by the principal investigator. It consists of two large sections, as described below.

a) The first section is subdivided into four differentiated parts:

1. Characteristics regarding demographic, educational, and socioeconomic data, as well as those related to habits and customs. This set of questions includes demographic variables (gender, place of residence, and place and province of birth), academic training variables (parents' or legal guardians' education level), socioeconomic variables (parents' or legal guardians' occupational status), and student habits variables (use of the internet and social media, journeys made). These form the basis on which the results of the knowledge and competence tests can be contrasted with the environmental variables that could help to explain them. This set of items is part of the designed instrument which is, in turn, an online tool for geographic data gathering. Thus, a list of 28 test items unfolds, drawn up to capture the degree of knowledge and geographic-spatial competences, based on the curriculum established by the LOMLOE (Organic Law Amending the Organic Law of Education) for the area of geography and history in the third year of compulsory secondary education.
2. Spatial knowledge measurement through a single-answer test that is based on a previous study (Battersby & Montello, 2009) and consists of nine questions about the dimension of Earth's large units of land.
3. Measurement of Spanish geography knowledge. A nine-curricular-question form on Spain's geography, albeit with topics that are tied to students' current reality and their experiences, likes and dislikes, and habits (Raento & Hottola, 2005).
4. Global geography knowledge measurement. It includes 10 curricular questions on world geography (Reynolds & Vintereck, 2016).

b) The second part of the instrument is the most innovative. Its development required the technical contribution of geographic information system (GIS) programming specialists. Indeed, the second part is an online map editor instrument for the development of PLK assessment exercises. It consists of 26 questions that require participants to locate on a digital map the places that correspond to the correct answers to the previous 28 curricular questions. Once the place has been located on the map as a waypoint, the application automatically produces a double assessment. It first indicates whether the answer or chosen location is correct or not (using binary values 1 and 0); besides, it points out errors or inaccuracies, counting the number of kilometers between the location assigned to the place and its real location.

The implementation of the Geographical knowledge test for compulsory secondary education students generated a.csv file for each of the participating centers. The .csv files obtained were converted to .xlsx (Excel 2016), after which the information was collected in a single database that gathered the answers of the 275 students who participated in the pre-test. Excel 2016 and SPSS (SPSS 29) were the applications used for the statistical processing of information.

As mentioned, a set of 6 scores for the cartographic and geographic knowledge (content) and the ability to correctly locate places (PLK) of the participating third-year compulsory secondary education students was obtained. The first three belong to the area of curricular contents on spatial knowledge (dimensions of regions and countries), local knowledge (geography of Spain), and global knowledge (world geography). The other three assess the ability to correctly locate the places (PLK) that were the right answers to the previous questions. The curricular content questions are based on the new curriculum established by the Organic Law Amending the Organic Law of Education (LOMLOE) and are also inspired by current aspects and phenomena that are often the subject of wide media coverage (Raento & Hottola, 2005).

Before using it with the students of the selected centers, the instrument and procedure were approved to be implemented in secondary education centers by the Research Ethics Committee of the University of the Balearic Islands. Moreover, after obtaining a favorable report from such committee, during March, April, and May 2023, the instrument was subjected to a process of validation by expert judges (application of Aiken's *V* method), and its reliability was determined through a pilot test conducted with a sample of 136 students and the use of the Kuder-Richardson formula (Pérez & Abad, 2021).

The test was conducted on 4, 5, 6, 9, 10, 11 and 13 October 2023. The schedule of each social science department, the geography and history subject timetable for the third year of compulsory secondary education groups that participated, and the intention of avoiding overlapping of the tests of different groups from different centers explains why it extended over more than 2 weeks.

To answer the test, the students used their mobile devices, or the personal computers made available to them by the centers. The test lasted an average of 20-25 minutes and was carried out in the framework of the Geography and History compulsory subject.

#### *Data Analysis*

These three scores were statistically analyzed, establishing associations with indicators of socioeconomic status, cultural status, habits, and gender of the participating students to provide answers to the research questions (RQs).

To do so, the three indicators mentioned above (continuous dependent variables) were associated with mostly categorical and ordinal, but also certain continuous variables. The statistical tests used for this purpose were Pearson's correlation coefficient, Student's *t*-test for independent samples, and one-way analysis of variance (ANOVA), according to the type of independent variable being examined (numeric, dichotomous, or categorical with three or more categories).

#### **Research Results**

The pre-test results are subdivided into six separate blocks (three on content and three on PLK). The first includes the assessment of the spatial knowledge of the participating students based on nine questions where the dimensions of Spain are compared with those of other countries or regions. The participating students obtained an average score of 6.53 out of 10, which is above the minimum (5) and reveals average knowledge of large areas in the world. In the second part of the questionnaire, they assigned a location to the places that were the correct answer to the content questions on spatial competence. The nine regions or countries were located, not always correctly, in disparate places of the geography. The places that were correctly located, obtaining the highest percentage of scores, were the Russian Federation, Antarctica, and Italy. The first two are very large and easily measurable areas, regardless of the distortive effect of the Mercator projection, and the latter is an almost neighboring Mediterranean peninsula. The average score of the participating students was 4.4 out of 10, thus demonstrating a poor wealth of knowledge that is below the minimum.

Besides, both variables (content and its PLK homonym) are interrelated, with a significant Pearson's correlation coefficient value of  $r = .458$  ( $p < .001$ ).



**Table 2**  
*General Spatial Knowledge Results*

Spatial Knowledge test	Answers	% (correct answers, content)	% (correct location, PLK)
State whether the following world regions are larger or smaller than Spain			
Antarctica	Larger	82	58
Austria	Smaller	65	16
North Korea	Smaller	45	21
Russian Federation	Larger	96	91
Greenland	Larger	65	51
Italy	Smaller	57	64
Japan	Smaller	36	36
South Africa	Larger	89	32
Sweden	Smaller	52	24

The results for competence in local geography knowledge were also discouraging (see Table 3). From the total of nine questions, the students scored an average of 3.8 out of 10 in content. The highest percentage of correct answers (59%) was achieved by the question “*You have been invited to spend your summer holidays in a Spanish city. Where should you take warm and rainproof clothes?*”. In turn, the students’ average in the test in which they were to locate those places (PLK) was 2.6 out of 10. The value of Pearson’s correlation coefficient between both variables is average ( $r = .391$ ) and significant ( $p < .001$ ).

**Table 3**  
*General Results for Knowledge of Spain’s Geography*

Spain’s Geography test	Answers	% (correct content answers)	% (correct location, PLK)
The following province of Spain has an oceanic climate agricultural landscape with enclosed fields of natural meadows used for livestock grazing and forestry development.	Asturias	28	41
You have been invited to spend your summer holidays in a Spanish city. Where should you take warm and rainproof clothes?	Bilbao	59	15
Which inhabited Balearic Island can only be reached by boat?	Formentera	21	25
Amancio Ortega founded Zara in La Coruña in 1975. What autonomous community does this city belong to?	Galicia	32	72
The first National Park founded in Spain in 1918 was Ordesa y Monte Perdido, which is located in the Spanish province of:	Huesca	15	12
The autonomous community where San Fermin is held annually in July is single-province. Which of the following autonomous communities is also single-province?	La Rioja	31	35
Beaches are a first-rate tourism resource in Spain, favoring the arrival of millions of tourists and allowing much of the economic activity to be located in coastal areas. Which of the following provinces has a shoreline?	Málaga	58	15
Many sub-Saharan people try to reach Europe through Spain, sometimes illegally. This gives rise to confrontations between the police and migrants. Recently, there have been several episodes of violence in the Spanish city of:	Melilla	56	8
Which of the following provinces is undergoing a continuous process of depopulation?	Teruel	41	13



The results achieved in the detection test for global geographic knowledge competence are also very weak (see Table 4). The average score obtained by the participating students was 4.24 out of 10 in the 10 content questions. On the other hand, they achieved 3.06 out of 10 in the ability to locate such places, regions, or countries. Both scores show an average and positive Pearson's correlation coefficient of  $r = .451$  with clear statistical significance ( $p < .001$ ).

**Table 4**  
*General Results for World Geography*

World geography test	Answers	% (correct answers, content)	% (correct location, PLK)
Most countries around the world experience an increase in the number and proportion of people over 65. Which of the following is the country with the highest proportion of people over 65?	Japan	23	33
Which of the following countries is a major receiver of migrants?	The United States	64	47
In which of the following countries is it easier to find a palm grove for palm oil production?	Indonesia	19	15
Most of the power we consume comes from oil. Which of the following regions is an important oil producer?	Persian Gulf	28	7
"Three-delight" rice is actually not a Chinese dish but more of an American creation. However, do you know in which region in the world is rice-growing predominant?	Southeast Asia	61	9
Which of the following countries is one of the world's greatest producers of minerals?	Democratic Republic of the Congo	37	18
What European country has been invaded by Russia?	Ukraine	89	35
What country is the French-speaking region of Quebec in?	Canada	22	51
Which of the following areas can be affected by the melting that is taking place as a result of global warming?	Greenland	64	51
In South America, could you mark where there is a characteristic warm Mediterranean climate?	Chile	19	41

The question with the highest number of correct answers in the first part is the one that refers to the current war in Ukraine. Thus, *Which European country has been invaded by Russia?* was correctly answered by 89% of participants. On the other hand, Canada and Greenland obtained the highest percentage of correct answers as to their location on the map (51%). Meanwhile, the worst results regarding location corresponded to Southeast Asia and the Persian Gulf, as they are not areas with a clear border (political or physical) and because of the distance they are at.

A set of six assessments of the participating students' spatial, geographic, and cartographic competences, as well as their ability to correctly locate places (PLK) was obtained. Three belong to the three-dimensional area of curricular content: spatial knowledge (content related to the sizes of regions and countries); local knowledge (content regarding the geography of Spain); and global knowledge (world geography content). The other three belong to the area of capacity to accurately locate places that are the correct answer to the curricular content questions (PLK). Both sets, contents and PLK, are interrelated. The Pearson's correlation coefficients between them yield positive, average-value results, all of which are statistically significant ( $p < .001$ ). The local-global interrelation (including spatial knowledge about the size of regions around the world) yields the lowest results, with correlations below .4 (in content and PLK scores, as well as between both sets) (see Table 5).



**Table 5**  
*Pearson's Correlation Coefficients between the Six Assessment Results*

Six assessments results	Content A	Content B	Content C	PLK A	PLK B	PLK C
Content A	-					
Content B	.324**	-				
Content C	.406**	.542**	-			
PLK A	.458**	.415**	.446**	-		
PLK B	.311**	.391**	.329**	.578**	-	
PLK C	.473**	.327**	.451**	.847**	.493**	-

Note: A: Spatial knowledge; B: Knowledge of Spain's geography; C: Knowledge of world geography. \*\* $p < .01$

The six sets of scores obtained from the participating students' answers offer a separate balance of the geographic, cartographic, and PLK competences. To complete the intended analysis required finding a way to provide a global value to the score obtained to be able to establish relationships between the geographic and the cartographic competence shown and certain information regarding the respondent students' personal background that may have an impact on the assessment (gender, habits associated with the use of new technologies, journeys made). For this purpose, three assessments were obtained to sum up their scores: global score in content (summation based on 10 of the 3 content scores), global PLK scores (summation based on 10 of the 3 PLK variables), and the total score (sum of both scores). There is a significant correlation ( $p < .001$ ) of  $r = .579$  between both dimensions of the test (content and PLK). These global scores led to a new classification of the students into four groups, depending on their partial scores on each of the assessed areas (content and PLK).

The number of students who passed the minimum requirement is far lower in the PLK test (23.6%) than in the content test (50.2%), with a majority scoring below 5 out of 10 in both areas (43%). The smallest group is made up of 17 individuals who scored above 5 out of 10 in PLK and whose contents assessment, in turn, yielded scores below 5 out of 10 (6.2%) (see Table 6).

**Table 6**  
*Student Distribution according to the Assessment*

		Contents		Total	%
		Below 5	Above 5		
PLK	Below 5	120	90	210	76.40
	Above 5	17	48	65	23.60
	Total	137	138	275	100.00
	%	49.80	50.20	100.00	

#### *Relations between the Factors Associated with the Students' Environment and the Results*

First of all, the impact of gender was analyzed. The decision was made to study the interrelation between the geographic knowledge of boys and girls. The small group of 8 nonbinary students was not accounted for because the numeric difference is not large and including them would have involved a distortion of the results of the statistical measures used to calibrate the influence of gender on the acquired geographic knowledge.

An independent-samples *t*-test was performed based on the conviction that there are differences between boys and girls as regards their results in *total score*, *content score* and *PLK score*. In *total score*, there is a significant difference between the average scores obtained by boys and girls. On the other hand, Cohen's *d* yielded an average result. In *content score*, boys obtained a higher average than girls, albeit lower than the one in *total score*. This



difference between averages is statistically significant. Meanwhile, Cohen's  $d$  reflects a small effect size. Besides, boys achieved a higher average *PLK* score than girls which is significant according to Student's  $t$ -test. Finally, Cohen's  $d$  indicated a medium effect size (see Table 7).

**Table 7**

*Relation between the Scores Obtained on the test and the Participants' Gender*

Test scores	Boys		Girls		$t(263)$	$p$	Cohen's $d$
	$M$	$SD$	$M$	$SD$			
Content score	5.1	1.65	4.65	1.3	2.44	.008	.296
PLK score	3.9	2.3	2.87	2.02	3.77	<.001	.462
Total score	4.5	1.8	3.75	1.5	3.67	<.001	.446

*Internet use* (ordinal variable) and *use of social media, video games and other recreational uses of new technologies* (ordinal variable) are not interrelated with *total score*, *content score*, or *PLK score*. Despite the distance between the averages for both groups, independent-samples  $t$ -tests between *internet use*, which 258 participants stated as daily and 17 as occasional, were not statistically significant (see Table 8). The independent-samples  $t$ -test did not yield significant results either in the case of *use of social media, video games and other recreational uses of new technologies* (used daily by 220 participants and occasionally by 55), despite bringing to light subtle differences between both groups (see Table 9). As for distribution, the fact that daily use predominates by far in both cases would explain the lack of statistical impact.

**Table 8**

*Relation between the Test Scores and Internet Use*

Scores	Daily		Occasional		$t(273)$	$p$	Cohen's $d$
	$M$	$SD$	$M$	$SD$			
Content score	4.9	1.5	4.6	1.7	.79	.214	.199
PLK score	3.4	2.23	2.6	2.5	1.32	.188	.33
Total score	4.1	1.7	3.6	1.9	1.265	.103	.32

**Table 9**

*Relation between the Test Scores and Use of Social Media, Videogames and Other Recreational Uses of New Technologies*

Scores	Daily		Occasional		$t(273)$	$p$	Cohen's $d$
	$M$	$SD$	$M$	$SD$			
Content score	4.9	1.5	4.6	1.7	.79	.214	.199
PLK score	3.4	2.23	2.6	2.5	1.32	.188	.33
Total score	4.1	1.7	4.2	1.7	-.05	.311	-.074

However, the correlation between the different scores and the *number of hours a day spent using the internet* and the *number of hours a day spent using social media, video games and other recreational uses of new technologies* has a certain significance. Pearson's correlation coefficient between the scores and the number of daily hours spent on such uses yields negative, low, although statistically significant, results (see Table 10). Nevertheless, Pearson's correlation coefficient between the *number of hours a day spent using the internet* and the *number of hours a day spent using social media, video games and other recreational uses of new technologies* variables is significant ( $p < .001$ ), with a value of  $r = .843$ . Therefore, using the internet is clearly associated with leisure and recreation and, consequently, far from any academic learning intention.

**Table 10**

*Pearson's Correlation Coefficients between Global, PLK, and Content Scores and the Number of Hours a Day Spent Using the Internet and Other Online Recreational Uses*

	Internet hours a day	Hours a day spent on videogames and other recreational uses
Content score	-.147*	-.158**
PLK score	-.145*	-.159**
Total score	-.164**	-.178**

Note: \*  $p < .05$ ; \*\*  $p < .01$

Other habits displayed by the students have been linked to their pre-test scores. Indeed, the variables *consulting web maps* or *consulting paper maps* were taken into account according to the frequency of usage (1 daily, 2 moderately, 3 hardly ever). However, the relation between *total score*, *content score* and *PLK score*, and *consulting web maps* is not statistically significant. The statistical test used was one-way ANOVA, which yielded a significant result in PLK score, although the significance is near the threshold ( $p = .048$ ). As to the rest of the scores, despite subtle differences between the averages of the three resulting groups, the null hypothesis is not rejected (see Table 11). *Consulting paper maps* yielded similar results, although, in this case, there was not even a difference among averages that could respond to the use of this type of map (see Table 12).

**Table 11**

*Relation between Test Scores and Consulting Web Maps*

Scores	Daily		Moderately		Hardly ever		F(2,272)	$\eta^2$
	M	SD	M	SD	M	SD		
Content score	5.1	1.8	4.83	1.32	4.8	1.4	1.14	.008
PLK score	3.9	2.6	3.1	2.1	3.2	2.1	3.1***	.022
Total score	4.46	2.01	3.9	1.4	3.94	1.6	2.7	.02

Note: \*\*\* $p < .05$ .

**Table 12**

*Relation between Test Scores and Consulting Paper Maps*

Scores	Daily		Moderately		Hardly ever		F(2,272)	$\eta^2$
	M	SD	M	SD	M	SD		
Content score	4.98	1.8	4.5	1.6	4.9	1.5	1.5	.011
PLK score	3.3	2.7	2.8	2.1	3.4	2.2	1.3	.009
Total score	4.1	2.1	3.6	1.5	4.2	1.7	1.72	.013

Note:  $\eta^2$ : Eta-squared is a measure of effect size used with ANOVA. \*\*\* $p < .001$ .

There is an interrelation between *journeys made in the last three years* and *total score*, *content score*, and *PLK score*. Firstly, the result of the analysis of variance performed using *content score* and *journeys made in the last three years* as an ordinal categorical variable was statistically significant; thus, the null hypothesis is rejected because the probability that the means of the groups are equal to or below .1% is low (see Table 8). However, the result of Levene's test was nonsignificant ( $p = .270$ ), which does not reject the null hypothesis because there is a 27% probability that the three groups have the same variance. Consequently, the post hoc Bonferroni correction was used, which yielded a statistically significant difference ( $p < .001$ ) between those who rarely travel (fewer than 1 journey) and those who have made more than 5 journeys, and between those who have made 2 to 5 journeys and those who have made more than 5. Secondly, the analysis of variance performed using *PLK score* and *journeys made in the last three years* yielded significant results. On the other hand, the result of Levene's test was nonsignificant ( $p =$

.248), and there are, therefore, no differences between variables. The *post hoc* Bonferroni correction test revealed the same significant differences as in the case of content scores. Finally, *total score* and *journeys made in the last three years* reveal a similar relationship to the one obtained for the two partial scores. The F-value is significant, which proves that the means of each group are different from each other. On the other hand, Levene's test yielded nonsignificant results ( $p = .417$ ), supporting the null hypothesis. The Bonferroni post hoc test revealed statistically significant differences in the means of the same groups as in the partial scores. Nevertheless, the value of partial Eta squared is low for the three scores (see Table 13).

**Table 13**  
*Relation between Test Scores and Journeys Made in the Last Three Years*

Scores	Fewer than 1		Between 2 and 5		More than 5		F(2,272)	$\eta^2$
	M	SD	M	SD	M	SD		
Content score	4.7	1.5	4.7	1.4	5.9	4.9	9.05***	.06
PLK score	3.2	2.2	3.1	2.12	3.34	2.25	8.56***	.06
Total score	3.96	1.6	3.9	1.6	5.4	1.84	11.26***	.08

Note:  $\eta^2$ : Eta-squared is a measure of effect size used with ANOVA; \*\*\* $p < .001$ .

Other circumstances associated with students' family environment have also been analyzed. Indeed, one-way ANOVA tests have been used to compare the occupational status and academic training of both parents with the three scores obtained. Despite the differences in means, there are no instances of statistically significant relations, and therefore, they do not follow any pattern and are subtle rather than important. There is no statistically significant difference in any of the cases.

## Discussion

The scores achieved by the students who participated in the pre-test (275 from 8 compulsory secondary education centers) can be described as poor. Their average marks in the content sections (spatial knowledge, geography of Spain, world geography) are below 5 out of 10, except for spatial knowledge (6.53). The latter is largely due to the binary nature of the questions, which made it easier for students to answer correctly. On the other hand, the scores in the partial PLK tests are even lower than the partial averages for content.

This pattern also appears when the global score for content and the final PLK scores are compared. Indeed, 23.6% of participants scored above the required minimum for PLK, while a majority of the participants (50.2%) passed the minimum of 5 out of 10 in the global content test. Nevertheless, the partial scores in content show that only the spatial knowledge content questions of the test are passed (average: 6.53), while the average scores in knowledge about the geography of Spain (average: 3.41) and the world (average 4.24) fall below the acceptable minimum. In essence, students know more about the world than about Spain or their own autonomous community.

Despite the bewilderment caused by the poor results, context provides significant patterns in the students' answers. In general, the places are known because of their recent or ongoing media coverage, as is the case with Ukraine (at the height of a war against the Russian Federation), the United States, Southeast Asia, Teruel (as an example of the so-called 'empty Spain'), or Melilla (migration border conflict). The influence of the media and their coverage of a place as an explanatory factor is also present in the studies conducted by Torrens (2001) and, more recently, Hagge (2023a). The places whose location is most accurately provided are large, quasi-continent-sized regions (Antarctica, Russian Federation), countries or regions and cities located on the ends of continental landmasses bordering the ocean (Galicia, South Africa, Italy, Malaga, Bilbao), and, also, large islands (Greenland). However, this is not the case with inland places (Democratic Republic of the Congo, La Rioja, Huesca, Teruel, Melilla), those that are far away and dispersed within their unit (Indonesia), or places corresponding to a country, island or continental landmass with blurred borders (Persian Gulf) or are far away (Ukraine and Southeast Asia). According to the findings of Battersby and Montello (2009), small regions are oversized in relation to large ones, especially when there is a considerable distance from the equator. Other studies on PLK also note the importance of distance (close vs far) and being an island (Torrens, 2001) as common patterns in the participating students' geographic knowledge and competences.

Gender influences the results of students' geographic learning. Boys obtained higher averages than girls in the three final tests, in contents, PLK and as regards the overall results. This difference is statistically significant. Moreover, this finding is common to other studies on students' PLK (Torrens, 2001). However, gender differences become blurred with age, which is a factor that has not been considered in this research as it is focused on students taking the same academic level (Francek et al., 1993). Even Lawton (2018) reported boys' greater accuracy in locating a city on a world map, while gender differences become weaker as regards distances and directions between places.

The explanatory power of students' technological context is very low. However, certain data provide strong clues as to the role that technological devices currently play among teenagers. Firstly, there is a very important relationship between the use of the internet and its recreational use (video games and other purposes) with a significant and very high Pearson's correlation, which shows that compulsory secondary education students associate the internet with leisure rather than seeing it as an academic learning resource. Proof of this is that consulting or viewing maps online, using digital versions, or on websites is hardly significant; therefore, there is no relationship between good geographic learning outcomes and the interest in using digital maps. On the other hand, there are also low but significant negative correlations (quite logically) between partial and total scores on the test and the number of hours spent on the internet and video games, which confirms that we are before young people who are permanently conditioned by a digital reality that is linked to leisure and hardly ever becomes a geographic learning resource.

On the other hand, certain indicators of students' socioeconomic status, as well as of the cultural level of their family environment, such as journeys made, play an influential role. There is a statistically significant relationship between test results and journeys made; thus, students who have traveled more than five times over the last three years have achieved higher averages in the geographic knowledge and mapping skills tests than those who hardly ever or never travel. In an Ireland-based study, attempting to find explanatory reasons for place location knowledge, Torrens (2001) also found a relationship with the journeys made by students.

Finally, neither parents' occupational status nor their academic training bears any statistically significant relationship with the test results. Their use as explanatory variables in the study answers to previous experiences where such factors had explanatory power according to statistical tests (Binimelis-Sebastian et al., 2023a).

The results show the little importance attached to geography by the new generations of adolescents. The questionnaire was drawn up by a discussion group consisting of researchers and compulsory secondary education teachers who are knowledgeable of the new basic contents of the curriculum established by the LOMLOE, of *future 2*, which represents the transition from a knowledge-based to a competence-based curriculum where students are expected to be free learners against the experts' authoritarianism (Young & Muller, 2010). On the other hand, the questions were prepared considering geographic contexts that the students were familiar with because of the relevance given to them by the media (Raento & Hottola, 2005) or because they belonged to their everyday geographies (Raento & Hottola, 2005). Indeed, place location is a skill that involves understanding cartographic language which is, in turn, a competence that is also part of the new curriculum.

The variables used to explain the results do not gather all the aspects of the students' personal environment that could have an impact on their academic success in the area of geography (habits, customs, or socio-educational, cultural, and socioeconomic contexts). Despite this, the reasons that explain the poor results achieved by the students who have participated in the test are clearly of a more structural than personal nature. Strictly from the angle of education methodology, Stimpson (1991) advised discontinuing rote learning in favor of trying to explain the location of places in their environmental context, believing that the former only builds ephemeral knowledge and fosters negative attitudes towards learning. In a recent study, McFarlane (2024) claimed that the lack of geographical content in the U.S. compulsory education system, alongside inaction by a government whose educational planning is dependent on market demands, would explain the population's poor geographic and spatial knowledge and abilities in a cultural context with clear prejudices against other cultures. In Spain, scholars who are concerned with geography education have also focused on structural issues such as the residual role to which geography is confined in our education system (De Miguel, 2018, 2022). Nonetheless, this study and the research project that it is part of are an attempt to find a new approach to geography teaching that is very closely linked to the language, use, and meaning of maps as unique and indispensable for understanding where and why something happens. The findings show that the geographic knowledge and competences of the participating students are very poor. The intervention scheduled in the pilot centers involves the tool that has been prepared to find a solution to this issue and reverse the situation. However, the study has certain limitations. First, the test items, defined as a result of the conclusions reached by a discussion group consisting of researchers and secondary education teachers, could have been others, which would unquestionably have an impact on the results. Even so, their elaboration responded



at all times to the established curricular knowledge and competences. Secondly, the instrument for automatically gathering geographic data can be improved in the future to offer numerical results for the scores obtained (which we are now assessing), as well as cartographic results (which would improve the analysis). We are aware that it is the first achievement of a very ambitious goal that will require, once the project has been completed, new replicas in the form of further research, as well as the transfer of results to the education community.

## Conclusions and Implications

The analysis and study of the data obtained from the pre-test carried out among third-year compulsory secondary education students clearly provides answers to the research questions (RQs) raised at the beginning of the research. Moreover, some of the results (especially those associated with the socioeconomic status of the students' families) show a reality that breaks with certain clichés that are often present in geographic literacy studies.

Firstly, the participating students show a poor level of curricular knowledge in the area of geography (according to the current curriculum established by the LOMLOE), as well as a scarce capacity or ability to locate places on a map (PLK). The PLK scores are always below the global or partial curricular knowledge scores. In fact, 50.2% of participants exceeded the content pass score (more than 5 out of 10), while only 23.6% passed the PLK test. On the other hand, the participating students did not pass all the curricular content. The averages for Geography of Spain (local area) and World Geography (global area) were below the minimum of 5 out of 10. The only average above 5 (6.53) was obtained in the partial score for spatial knowledge.

Secondly, there is a correlation between curricular knowledge and PLK scores, which shows at the global level and in the partial scores of both of the areas assessed. Thus, those who know the contents are also skilled in place location and vice versa. Islands, regions, and countries that are nearby, areas that are a current media topic, and regions that are close to the sea and, therefore, define the outline of continental landmasses, are better known and more accurately located than inland regions or countries.

Thirdly, family background (socioeconomic and socio-educational), as well as personal circumstances (gender, education, habits and customs) partially explain the results. The analysis of the findings leads to the conclusion that there is a gender bias so that boys achieve better results than girls. This gap is greater in PLK than in content scores. The journeys made in the last three years, which are, in turn, an economic and cultural status marker, are another factor that influences the total score, as well as the content and PLK scores. Compulsory secondary education students' close contact with new technologies is unquestionably associated with recreational uses rather than their use as a teaching tool for geography learning. The variables corresponding to parents' academic training and occupation bear no relation to the results obtained by the participating students.

Finally, this research has also demonstrated the usefulness and novelty of the *Geographic knowledge questionnaire for compulsory secondary education students* which allows an automated, real-time, accurate gathering of PLK data from the participating students. Therefore, it is a novel tool for the study of geographic literacy, designed using new information technologies and with a high potential for the development of this line of research on geographical literacy in a variety of educational cycles.

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## Declaration of Interest

The authors declare no competing interest.

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