International Journal of
Geo-Information

MDPI

Article

Dynamic Analysis of School Mobility Using Geolocation Web Technologies

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Abstract: Pedestrian travel represents one of the most complex forms of mobility owing to the numerous parameters that influence its analysis and the difficulty of acquiring accurate travel information. In addition, the vulnerability of its protagonists, especially in urban environments, in coexistence with other types of transport, makes its study interesting. This paper proposes a web tool for use in geolocated surveys that allows the acquisition of georeferenced thematic information of interest for mobility studies. The analysis of different school routes from students' homes to their respective schools has been proposed as a case study. This work covered a sample of 1883 students from 26 schools in Galicia (Spain), where population dispersion generates a particular type of mobility. We obtained relevant mobility data, such as the routes most traveled by students in their daily commute to school, the most efficient routes, the most used means of transport, or the exact location of various elements that hinder and dangerously affect students traveling these routes, such as sidewalks or crosswalks in poor condition, among others.

Keywords: pedestrian; pedestrian mobility; school mobility; school routes; urban mobility; pedestrian paths; geolocated surveys

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Citation: Fernández-Arango, D.; Varela-García, F.-A.; López-Fernández, J. Dynamic Analysis of School Mobility Using Geolocation Web Technologies. *ISPRS Int. J. Geo-Inf.* **2023**, *12*, 8. https://doi.org/10.3390/ijgi12010008

Academic Editors: Hartwig H. Hochmair and Wolfgang Kainz

Received: 30 September 2022
Revised: 13 December 2022
Accepted: 23 December 2022
Published: 29 December 2022

1. Introduction

Traveling to school is one of the most sensitive mobility behaviors in terms of road safety, given that the main protagonists are children. It is estimated that daily school trips account for seven out of ten journeys undertaken by children between 5 and 18 years of age. These data make the protection of the most vulnerable road users, which include children [1], the elderly, cyclists, and pedestrians [2], one of the priorities of the Road Safety Strategy of the Directorate-General for Traffic (DGT) of Spain, which is why this type of travel is of particular interest for analysis. According to the research of [3], 70% of Spanish children do not travel to school alone. Furthermore, most of them walk accompanied on many occasions by parents or grandparents, especially in small towns. This fact reinforces the presence of vulnerable users in these school trips, as they often involve pedestrians, including the elderly and children.

The initiatives of the 15-Minute City that are being implemented in multiple cities around the world in recent years [4–6] have demonstrated effectiveness in creating friendlier and safer environments for pedestrians and wheelchair users globally. However, school mobility remains a mode of travel that requires specific analysis since the significant number of students, in coexistence with other means of transport—according to [3], school or public transport accounts for 18% and private vehicles for 40%—adds another risk factor for traffic accidents. This, together with the seasonal nature of these movements, concentrated at school start and end times, causes occasional congestion in areas close to schools, and various traffic conflicts that place drivers and pedestrians at risk. If we add to this the incorporation of private transport, collective transport, cyclists, and pedestrian traffic, we can see that school trips generate a particular form of mobility that must be addressed from a special approach compared to other types of traffic-generating activities. In this field, stand out studies include [7], which analyzes the Green and Safety School program in the Calabria region, or [8], studying the availability and state of conservation of sidewalks as a fundamental element for the improvement of pedestrian mobility in urban areas.

In Spanish schools, bus routes are regulated by [9], which publishes some general criteria to be taken into account when defining bus routes. However, the lack of regulation to define pedestrian routes means that most schools do not have defined pedestrian routes. It is generally the schools themselves or organizations in charge of promoting sustainable mobility [10–14] that promote these routes considering the students' addresses based on information recorded on their registration forms, simply prioritizing the proximity to the school. Knowledge of the location of the student's homes is essential with respect to establishing appropriate mobility policies in each of the educational centers for planning general public and school public transport routes. To design a safe school route, it is important to account for aspects such as the state of the streets, their technical characteristics, the location of obstacles for pedestrians or wheelchair users, or the location of possible problematic points on routes that may affect the safety or comfort of pedestrians. Acquiring this information is currently possible through collaborative participation; however, transferring this information to a Geographic Information System (GIS) that allows their integrated analysis with road data and other territorial information, requires the use of complex geopositioning processes, in addition to the data protection criteria that must be met. Most surveys conducted thus far focus on identifying the mobility of a population based on generic geographic references, such as municipal environments. However, there exists a scarcity of published literature that focuses on the real and detailed location of the origins and destinations of users because they require significant resources for performing adequate analysis. On many occasions, they simply work with a combination of travel times and distances. For instance, in the work of [15], the authors' design project employs a questionnaire on mobility, but without offering specific locations regarding origin points of the trips. Novel information and communication technologies offer an infinite number of new possibilities to citizens and administrations, which they are applying more or less rapidly to their activities. In addition, they offer services that many researchers can use in their projects to obtain data of high scientific value that would otherwise be impossible to acquire by traditional means, as [16], that identified different levels of walkability of a pedestrian network or [17], that uses multiple information sources to model city infrastructure and to calculate accessible routes. Studies such as [18] show that the increasing focus on sustainable travel has generated a demand for pedestrian and cyclist travel data acquisition and management. Notably, an increasing number of tools for mobility information acquisition are becoming available. However, obtaining information directly from those involved in mobility is something that has not been studied in depth until now. This is the case of geolocation web techniques, which make it possible to obtain the geographic location of respondents in addition to those of a given number of questions asked online. These methodologies confirm the assertion of [19] that 100% of the information and data handled globally have a spatial component that allows them to be referenced on the territory. As a result of this idea, the Emapic initiative arises, which will be the application on which the data acquisition for this project is developed, as we will detail in the following section. However, among the technologies for creating geo-referenced surveys, there are also other initiatives present within what we can include in public participation geographic information system (PPGIS). We can cite some such as Maptionnaire, used for example in participatory mapping of cultural ecosystem services in Madrid [20] or for understanding children's neighbourhood destinations in Auckland, New Zealand [21]; Ushahidi, an open source software application based in volunteered geographic information (VGI) used in projects such as citizen earthquake science in Taiwan [22] or a surveillance system for road traffic crashes in Burkina Faso [23]; ArcGIS Survey123, a simple and intuitive form-based data capture solution for creating, sharing and analysing surveys within the ArcGIS system promoted by ESRI used for example in a study on tourism-related stress [24] or to study the impacts of the COVID-19 pandemic [25].

An essential function in the life of a municipality is the level of mobility of its citizens. Knowing how they move and the route they use to access a particular public facility can help to establish policies and mobility plans focused on the needs of each of them. Geolocated survey technology makes it possible, in addition to locating the respondent, to request information on the linear routes they take or the identification of conflictive points in their journeys, among other issues of interest. If the mobility of daily users of a public center (for example, an educational center) is studied with precise geographic data, it is possible to obtain relevant data to establish sustainable mobility policies. This will make it possible to promote safer and more adequate pedestrian routes on the most frequented routes, adapting public transport in the area or promoting forms of shared trips.

This work aims to examine the scope of our geolocated survey web application Emapic (https://emapic.es/ (accessed date: 28 August 2022)) as a tool to acquire georeferenced information on school mobility, to study the characteristics and specificities of the students' journeys to their respective schools. The tasks carried out are part of the Geomove (https://cartolab.udc.es/geomove/ (accessed date: 28 August 2022)) project, in which the specific case of different schools in Galicia (Spain) has been studied. This region, located in the northwest of Spain, has a population of 2,695,645 inhabitants, according to [26], with the majority residing in main cities (Vigo, A Coruña, Ourense, Lugo, Santiago de Compostela, and Pontevedra) and coastal municipalities located in the southwest of the region, well connected by road through the AP-9 highway. However, the population in Galicia is characterized by its dispersion, especially in rural areas, which generates a unique type of mobility.

In Section 2, the scheme of the web application Emapic (https://emapic.es/ (accessed date: 28 August 2022)), the specific developments created for mobility analysis and the sample obtained in the case study of this work are described. In Section 3, the results obtained are shown; in Section 4 these results are discussed and compared with those obtained in other related works. Lastly, in Section 5 concluding remarks are provided.

2. Materials and Methods

The methodology used in this work was divided into two main phases: (I) developing the technology necessary to carry out the geolocated surveys and (II) analyzing the data obtained from the surveys to extract results and conclusions on school accessibility in the participating centers.

2.1. Development of a Geolocated Survey System

To develop a web tool for geolocated surveys where geographic reference was a fundamental aspect of the surveys, it was necessary to improve the functionalities of the Emapic (https://emapic.es/ (accessed date: 28 August 2022)) application, developed by the Advanced Visualization and Cartography Group of the University of Coruña, and adapt them to the specific requirements of this project. These improvements include the creation of a multi-parametric web map viewer, which allows identifying the geographical location of the schools and, at the same time, collecting of the user's location thanks to automatic or manual location strategies, associating all the user's answers to their geographical representation. This allowed analysis of the acquired data not only statistically, but also spatially. In addition, this application offers the possibility to survey an unlimited number of students and educational centers, without the need to implement additional resources if the survey is extended to a larger number of respondents, regardless of their location or size.

2.1.1. Emapic

Emapic (https://emapic.es/ (accessed date: 28 August 2022)) is a web tool whose function is to carry out geospatial surveys, combining the alphanumeric data collection of traditional online surveys with the possibility of adding the geographic component of the user's location, allowing both the visualization of the data on a map and the obtaining of more complex geometric analysis and correlations between the answers and their geographic areas.

It is a web development made with a set of HTML5, CSS3, and JavaScript technologies. As a general JavaScript library jQuery is used and for the layout, Bootstrap is used as a base, complemented for more complex elements of the user interface with jQueryUI (jQuery extension). For queries, filtering, and data representation, the Javascript libraries Crossfilter, D3.js, and dc.js are used, in the latter two cases, especially for use in the representation of statistical graphs. For cartography, there is a geographic viewer made with the open-source JavaScript library Leaflet, which uses HTML5 and CSS3 for the representation of interactive maps on the web. The viewer has different elements of interaction with the map already offered by Leaflet. The cartographic layers used in the viewer are taken from OpenStreetMap (OSM) and satellite images provided by Mapbox, although there is the option of using other cartographic web services.

The server code is based on node.js, storing the data in a PostgreSQL database with the PostGIS module, which allows storing and processing of the geographic component. The project, and especially the data model, was inspired by many of the functionalities present in the free software project LimeSurvey. The application receives the survey data from the server in Geojson format, a variant of the Json format for storing JavaScript objects in plain text, which also includes spatial information. Figure 1 shows the structure of Emapic (https://emapic.es/ (accessed date: 28 August 2022)) and its code is published in Github/Emapic (https://github.com/Emapic/emapic (accessed date: 28 August 2022)).

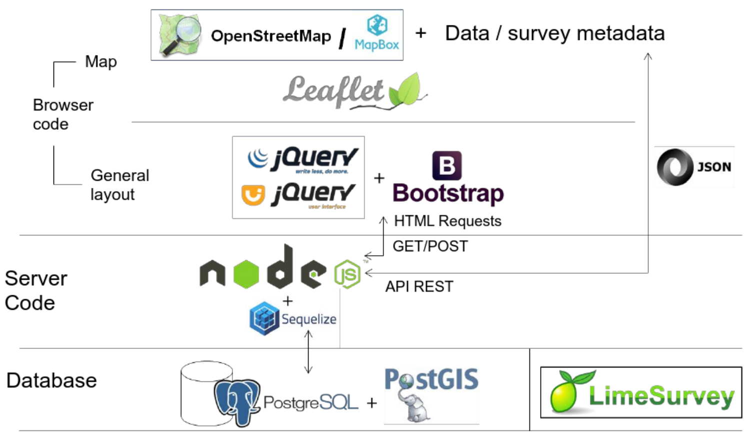

Figure 1. Emapic architecture.

2.1.2. Specific Customization for the Geomove Project

The specific developments on Emapic (https://emapic.es/ (accessed date: 28 August 2022)) for the Geomove (https://cartolab.udc.es/geomove/ (accessed date: 28 August 2022)) school mobility project consisted in the creation of two questionnaires that have been translated into Spanish, Galician and Valencian languages.

The first questionnaire [27] was used as a registration form for schools that wanted to take part in the project. The questionnnaire is employed to gather data about the school and its contact staff:

- School name
- Type of school financing: public, charter, or private school
- Number of students, teachers, and other workers
- Educational levels taught at school: child education, primary education, secondary education, high school, vocational training, or of other types

Once this first form is sent, the data are stored in the Emapic database, reviewed manually, and then copied into another table in the database that stores only validated registrations. In this table, a unique password is assigned to each participating school and, by using this password, all persons belonging to that school can start answering the main questionnaire. This second questionnaire [28] allowed for an in-depth analysis of multiple questions that can group into four main categories:

- Characteristics of the respondent (student or center personnel). Although it is not necessary to identify information about the respondent, certain data of interest such as gender, academic year, etc., are requested.
- Mobility habits: modes of transport, timetable, companions.
- Perception of the route and preferences: services, safety, type of roads, etc.
- Cartographic data: location of the home, route layout, identification of troublesome points, etc.

To make it easier to understand and answer these web questionnaires, each participating school was sent a user's manual [29] that detailed the methodology to be followed.

Another improvement was to provide each survey with different spatial geometries. As can be seen in Figure 2, each participant could locate their home as a point, draw the route from their home to the school as a line, and locate problem points encountered along the route, up to a maximum of five points.

Figure 2. Digitization of the home–school route and location of problems in the environment.

The location of the participant's address is a mandatory element in the process of answering the questionnaire. To facilitate the location, a map of the area surrounding the participant's school is presented, which is already identified since the individual school password must be entered to enter the form. As school registration is an earlier process in which the geographical location of the school is also mandatory, this information is always available before students and teachers, or school staff participates. Once the point marking the location of the participant's home is available, it is possible to trace the route usually followed to travel from home to school. The system allows a line to be drawn that obligatorily connects the point of the home with the point of the educational center. This part of the questionnaire is optional, so if a student has difficulties drawing it, due to age, time, or any other reason, he/she can omit this step. It is allowed to zoom and change the cartographic background to get the clearest information to detail the route of the displacement with the maximum level of detail that each participant wants to use. It is also left as an optional step to indicate on the route some conflicting points (up to a maximum of five) or that present problem in the route. These points are characterized among several types (traffic, sidewalk, crossing, traffic light, or other) to be able analyzed later. In addition, comments can be added, both at these trouble spots and in other sections of the questionnaire.

2.2. Data

For the development of the project, data collection was carried out between May and December 2016. In total, 26 schools participated and the geographical dispersion of the centers studied covered 18 municipalities and the four Galician provinces. Most of the schools were located in urban populations and four in a rural environment. Of the total number of schools studied, 25 were public schools and 4 were charter schools. Regarding the number of participants, 1903 were students and 73 were school staff, this group comprised both teachers and other workers so the total sample studied was 1976 participants. A web map (https://emapic.es/custom/geomove-16/overview (accessed date: 28 August 2022)) has been created to collect the location, identification, and a number of participants of all the centers enrolled in the project.

The data acquired with the questionnaires has automatically stored in the Emapic (https://emapic.es/) database (a PostgreSQL (https://www.postgresql.org/ (accessed date: 28 August 2022)) relational database with geospatial support via PostGIS (https://postgis.net/ (accessed date: 28 August 2022)) in two different tables: one for the school registration form, and another for the main questionnaire that gathers the mobility data from school personnel and students. The full structure of these tables can checked in Appendix A. During the analysis, new tables have created to store intermediate data obtained when processing the original tables, associating different types of information. For the geostatistical analysis of the information, the computer programs R (https://www.r-project.org/ (accessed date: 28 August 2022)) and QGIS (https://www.qgis.org/en/site/ (accessed date: 28 August 2022)) were used.

2.2.1. Filtering and Debugging of the Obtained Data

Checking and Filtering of Age and Course Correspondence

Data checking and filtering outliers between the age and course fields were basic to avoid inconsistent results in the study. For this purpose, the theoretical ages of the pupils were established according to the level of education they claimed. Subsequently, this age was compared with the theoretical age of the course and a range of validity was obtained between −1 and +2 years. If the age and course data did not agree, both were excluded from the study. Of the 1903 initial records, 87 were discarded, finally obtaining 1826 records. The theoretical ages of the students according to the corresponding course are shown in Table 1.

Table 1. Theoretical ages of students according to educational level.

Educational Level in Spain	Educational Level in USA	Theoretical Age
Child Education	Kindergarten	<5
1st Primary education	Elementary school Grade 1	6
2nd Primary education	Elementary school Grade 2	7
3rd Primary education	Elementary school Grade 3	8
4th Primary education	Elementary school Grade 4	9
5th Primary education	Elementary school Grade 5	10
6th Primary education	Middle school Grade 6	11
1st Secondary Education	Middle school Grade 7	12
2nd Secondary Education	Middle school Grade 8	13
3rd Secondary Education	High school Grade 9	14
4th Secondary Education	High school Grade 10	15
High School	High school Grade 11	>= 16

Checking and Filtering of Home–School Route Times

Knowing the time of departure from home and arrival at school on the day of the survey, given by the respondents, we obtained the travel time that each student estimated he/she spent. To check the veracity of this time, two filters were established: one to eliminate times of less than 0 min and more than 120 min, and another to eliminate all times that were not within a range of ±50% of the theoretical time needed to travel the indicated route. In the latter case, the route between the indicated address and the corresponding school was previously calculated using the [30] algorithm and the distance obtained was given a travel time based on theoretical speeds established for each means of transport in previous studies such as [31,32]. These speeds were 4 km/h for pedestrians, 10 km/h for bicycles, and 30 km/h for motor vehicles. With the first restriction, 130 records cleaned, obtaining 1773 results, and with the second restriction, 1329 records cleaned, obtaining 574 valid data for route times. The travel time values that could be correctly validated were subsequently analyzed in the geospatial analysis.

Checking and Filtering of Family Data

The data acquired on the number of cars, bicycles, children, and persons in the respondent's household were filtered. In total, three filters were used:

- Number of cars and bicycles. All negative values and values greater than 10 were eliminated for both the number of cars and bicycles
- Number of children: values less than 1 and greater than 10 were eliminated for the number of children. In this case, the minimum value for each record was 1, since the wording of the question required the respondent student to be included in the count of children in the family
- Number of people: values less than 2 and greater than 10 whose ages were less than 16 years were eliminated

Home–School Route Distances Debugging

Of the total 1903 participating students, only 865 drew their home–school route. To validate these routes, the distance between home and school checked to ensure that it was greater than the distance in a straight line. In addition, the optimal route between the two points was used, comparing the distance of the drawn route with the distance of the optimal route obtained by network analysis. A validity range was established for drawn lengths between 70% and 130% of the optimal route. With these restrictions, a total of 608 records retained, 70% of the routes drawn.

Final Filtering of Student Data

A final count of all previously filtered records was performed to eliminate those containing a high number of null values (Table 2). Records with errors in three or more filters were removed from the study.

Table 2. Identification of invalid records.

Number of Null Records	Frequency	%
0	541	28.4
1	1193	62.7
2	149	7.8
3	13	0.7
4	2	0.1
5	4	0.2
6	1	0.1
Total	1903	100

2.2.2. Description of the Sample

The sample obtained consisted of 1883 participants and 26 educational centers in 16 different municipalities. Of these 26 educational centers, 22 were located in urban environments and 4 in rural areas. In terms of ownership, 22 were public schools and 4 were charter schools. Table 3 shows the list of participating schools, the basic data of the center, and the percentage of participating students.

Table 3. Schools participating in the Geomove project.

School	Council	Area	Ownership	Number of Students of the School	Number of Students Surveyed	% Share
CEIP A Gándara	Narón	Urban	Public	462	20	4.3
CEIP A Solaina	Narón	Urban	Public	500	23	4.6
CEIP de Laredo	Redondela	Urban	Public	153	68	44.4
CEIP de Piñeiros	Narón	Urban	Public	207	23	11.1
CEIP López Ferreiro	Santiago	Urban	Public	450	134	29.8
CEIP de Zalaeta	A Coruña	Urban	Public	227	42	18.5
CEIP Emilio González López	Cambre	Rural	Public	220	65	29.5
CEIP Juan Rey	Lourenzá	Urban	Public	125	22	17.6
CEIP Pérez Viondi	A Estrada	Urban	Public	447	20	4.5
CEIP Ponte de Xubia	Narón	Urban	Public	500	49	9.8
CEIP Santa Baia	Boiro	Urban	Public	98	75	76.5
CEIP Virxe do Mar	Narón	Urban	Public	210	85	40.5
CPR Ayala	Narón	Urban	Charter	350	104	29.7
CPR Jorge Juan	Narón	Urban	Charter	200	84	42.0
CPR La Salle	Santiago	Urban	Charter	1400	116	8.3
CPR Santiago Apóstol	Narón	Urban	Charter	630	209	33.2
Escola Domirón (CRA)	Narón	Rural	Public	62	10	16.1
Escola O Val (CRA)	Narón	Urban	Public	90	10	11.1
IES Agra de Raíces	Cee	Urban	Public	400	247	61.7
IES Coruxo	Vigo	Urban	Public	450	79	17.6
IES de Foz	Foz	Urban	Public	500	108	21.6
IES de Valga	Valga	Rural	Public	300	140	46.7
IES Fco. Daviña Rey	Monforte	Urban	Public	350	61	17.4
IES Monte Castelo	Burela	Urban	Public	120	49	40.8
IES O Mosteirón	Sada	Rural	Public	120	49	40.8
IES Maruxa Mallo	Ordes	Urban	Public	190	17	8.9
Total				9061	1883	20.8

The educational levels of the participants ranged from Child Education to High School, although the majority (69.4%) were between 5th Primary school and High school. The average age was 12 years and the gender distribution was balanced, with 943 female and 939 male students. Regarding their height, this presents a parameter of interest since the legal limit by which children must be seated in a restraint seat is set at 135 cm, according to [33], 1719 respondents measured taller than 135 cm and only 164 did not reach that height.

Students responded to the survey in three different ways: from school, with the help of a teacher or Geomove project staff, or from home, either with the help of a family member or on their own. According to the data obtained, 1687 surveys were answered from school, with the help of teachers, compared to 106 who answered from home with help and 90 alone.

Analyzing the number of home–school routes drawn by the students, 30.9% of the participants drew the route without errors. However, this percentage was not high enough to analyze the school routes, so we studied the optimal routes calculated from the location of homes and schools using GIS procedures and then worked with these calculated routes to serve 100% of the participants.

2.3. Statistical-Descriptive Analysis

A statistical-descriptive study of the data acquired was carried out to obtain a more effective reading, using frequency tables, histograms, or box plots, among other methods. The information acquired was divided into four groups, depending on the subject matter, (1) respondent characteristics (sex, academic level, etc.), (2) mobility habits (mode of transport, schedule, companions, etc.), (3) perception of the route and preferences (services, safety, type of roads, etc.), and (4) cartographic data, such as the location of the home, layout or identification of conflictive points.

2.4. Geospatial Analysis

The use of web map viewers to carry out online surveys on school mobility has made it possible to have at the same time the alphanumeric answers and the geographic locations of different elements consulted to the respondents. In particular, the location of the home address, the linear layout of the home–school route, and the location of problems along the route. All these spatial geometries are linked to the anonymous user who entered information in the questionnaire and are also directly related to the school to which the respondent belongs, whose geographical location is available. By visualizing the different elements provided (address, route and problems) on a map, the following information was already available:

- A representation of the area of influence of each school by the position of the addresses concerning the location of the center
- A reference of the most used streets in the routes to travel to the center
- A representation of the places near the school that presented some kind of problem

Using the potential of GIS and the different associated technologies, such as Web Map Services (WMS), Spatial Data Infrastructures (SDI) and geographic databases available on the Internet, it was possible to analyse the data obtained in the survey in depth. For this project, in which this type of information was obtained for the first time, the analyses carried out were:

- Optimal home–school routes: the study of distances between homes and schools, establishment of zoning by distances to each school, and analysis of the concentration of routes by road sections
- Analysis of the density of homes near the schools: count of homes in the area generated by distances to each school
- Analysis of the spatial concentration of problems in the routes

For the calculation of the optimal routes, network analysis has been proposed based on the vector and topological information of the road network provided by OSM, on which a calculation of optimal routes and paths was performed through the PgRouting service. The calculation of the optimal routes was carried out with the [30] algorithm, evaluating the possible routes, using only the existing roads within a maximum radius of 5 km concerning the bounding box defined by the location of the home and the school. The cost of road optimization calculation was established according to the length of the route, so the shortest distance routes were obtained through the network mapped in OSM. Once these routes were available, we identified those road sections (defined as lines between two intersection nodes) that had the highest frequency of use due to the coincidence of several routes of students going to the same school. The number of times that a student potentially used that section to get to school was counted, storing this value on the geometry of the corresponding section for later analysis, but without individually identifying any of the participants, so that only sections with more than three students were represented.

Another of the analyses performed was the identification of the zones of influence of each school, calculated as those places that can be reached by walking a certain distance along the road. The zones were compared with other studies that provided equivalences between walking times and distances traveled, such as [34]. The distance zones were as follows:

- First zone of 400 m, corresponding to 5 min of walking at a speed of 4.8 km/h
- Second zone up to 750 m, corresponding to 10 min of walking at 4.5 km/h
- Third zone up to 1000 m, corresponding to 15 min of walking at 4 km/h
- Fourth zone up to 2000 m, corresponding to 30 min of walking at 4 km/h

3. Results

3.1. Statistical-Descriptive Analysis

3.1.1. Usual Means of Transport

Figure 3 shows the most common means of transportation used to travel to school. 931 students (49.4%) usually used the car, compared to 767 (40.7%) and 456 (24.2%) who usually walked or took the school bus, respectively.

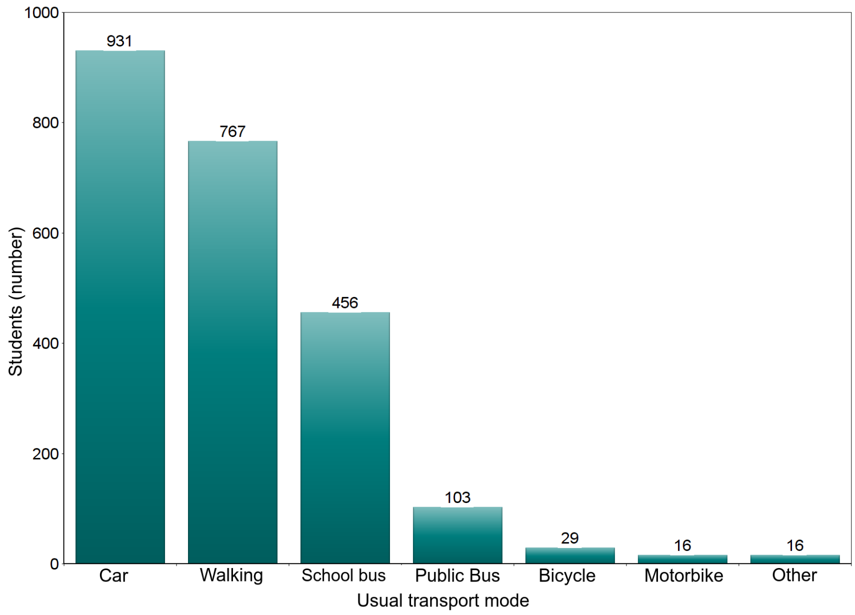

Figure 3. Most common means of transport on home–school routes.

Table 4 shows the combinations of means of transport used by the respondents, who mostly used some combination that included the car. Most often it was combined with walking (243 responses) and with the school bus (72 responses).

Table 4. Combination of means of transport used to travel to school.

	Walking	Car	School Bus	Public Bus	Bicycle	Motorbike	Other
Walking	767	243	31	15	20	4	5
Car		931	72	36	17	12	8
School bus			456	14	8	2	3
Public bus				103	3	3	3
Bicycle					29	2	1
Motorbike						16	1
Other							16

3.1.2. Accompaniment of Students

The autonomy of the students when traveling to school was analyzed. Figure 4 shows the people who accompanied the students on the trip. Parents appear most frequently, as 1012 respondents (more than 50%) were accompanied by one of them. This was followed by 25.4% (479 responses) by going alone, as opposed to being accompanied by a friend, which accounted for 21.2% (400 responses). These three options were by far the most common. On the other hand, childcare and family members less close to the student appeared to be the people who accompanied them to school the least often.

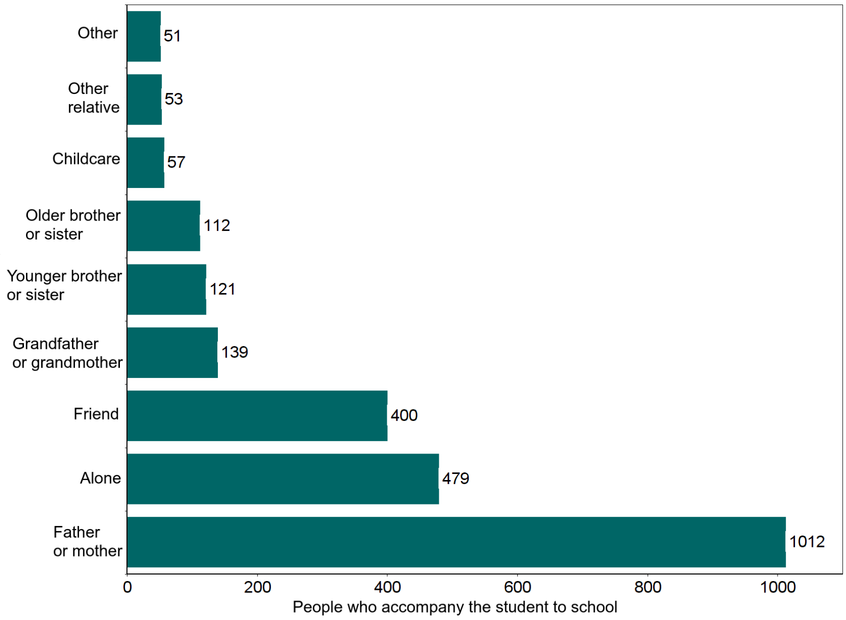

Figure 4. Most common means of transport on home–school routes.

At the Child Education and Primary School levels (Table 5), students used to be accompanied by parents (73.4%) and grandparents (12.0%) compared to 7.4% overall, surpassing those accompanied by friends, who vary from 21.2% to 7.6%. Going alone continues to be the second option, with 12.8%, especially in students in 5th Primary Education and 6th Primary School, which are the grades in which children begin to acquire greater autonomy. The youngest age at which students ever went to school alone was 8–9 years old.

Table 5. Accompaniment of Child Education and Primary School students. Percentages refer to the total number of students surveyed at the Child Education and Primary School levels (977).

	Child Education	1st PE	2hd PE	3rd PE	4th PE	5th PE	6th PE	Total	%
Parents	15	30	19	47	145	206	255	717	73.4
Alone	0	0	0	3	7	40	75	125	12.8
Friends	0	0	0	0	5	19	50	74	7.6
Grandparents	0	4	3	7	25	43	35	117	12.0
Younger brothers	0	1	0	1	10	24	40	76	7.8
Older brothers	0	2	2	3	10	23	13	53	5.4
Childcares	1	0	0	0	5	12	33	51	5.2
Other relatives	0	0	0	2	5	11	12	30	3.1
Other	0	0	0	1	7	7	8	23	2.4

These results changed radically when we analyzed the responses of students at levels higher than Primary education (Table 6). Walking alone to school was, in this time, the most frequent option with 36.2%, followed by being accompanied by a friend (34.4%). Parents continue to have a high frequency, appearing in third place with 28.8%, although they are only the first option for students in 1st Secondary Education.

Table 6. Accompaniment of students in Secondary Education (SE), High School (HS), and Occupational Training (OT). Percentages refer to the total number of students surveyed at the Secondary Education, High School, and OT levels (906).

	1st SE	2nd SE	3rd SE	4th SE	HS	OT	Total	%
Parents	85	72	54	14	33	3	261	28.8
Alone	58	93	86	26	54	11	328	36.2
Friends	75	85	81	17	47	7	312	34.4
Grandparents	11	2	3	2	0	0	18	2.0
Younger brothers	7	7	14	5	9	0	42	4.6
Older brothers	21	15	14	4	1	0	55	6.1
Childcare	0	0	4	0	0	0	4	0.4
Other relatives	6	6	4	0	6	0	22	2.4
Other	8	7	2	1	7	1	26	2.9

Taking into account that of the 1883 total respondents, 125 students in Primary Education and 328 in Secondary Education and High School traveled to school alone on some occasion, it was interesting to know what means of transportation this group used. For this purpose, Figure 5 shows a comparison of the means of transportation used on the day of the survey by students who reported that they usually went to school alone. The majority of respondents used to walk (48.6%) or take the school bus (31.7%) and in none of the cases studied was the bicycle used as a means of transportation.

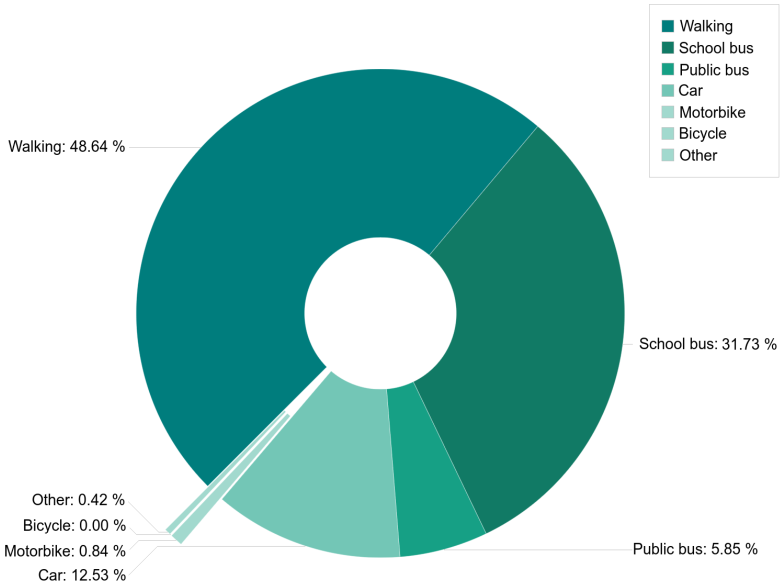

Figure 5. Means of transportation used by students who usually go to school alone (453 students out of the 1883 total respondents), on the day of the survey.

3.1.3. Home–School Travel Times

Figure 6 shows the travel times used for the home–school trip according to the departure and arrival times indicated in the questionnaire. The average value was 12 min and quartiles 1 and 3 (corresponding to 25% and 75% of the cases) were 6 and 20 min, respectively, indicating that 75% of the students reached their school in less than 20 min. The box plot whiskers (1) and (2) were calculated from the Interquartile Range (IQR) and showed values within a 1.5 interval below and above them, with outliers being considered outliers.

$$Whisker_1 = Q_1 - 1.5 * IQR = 6 - 1.5 * 14 = -15 \quad (1)$$

$$Whisker_2 = Q_3 + 1.5 * IQR = 20 + 1.5 * 14 = 41 \quad (2)$$

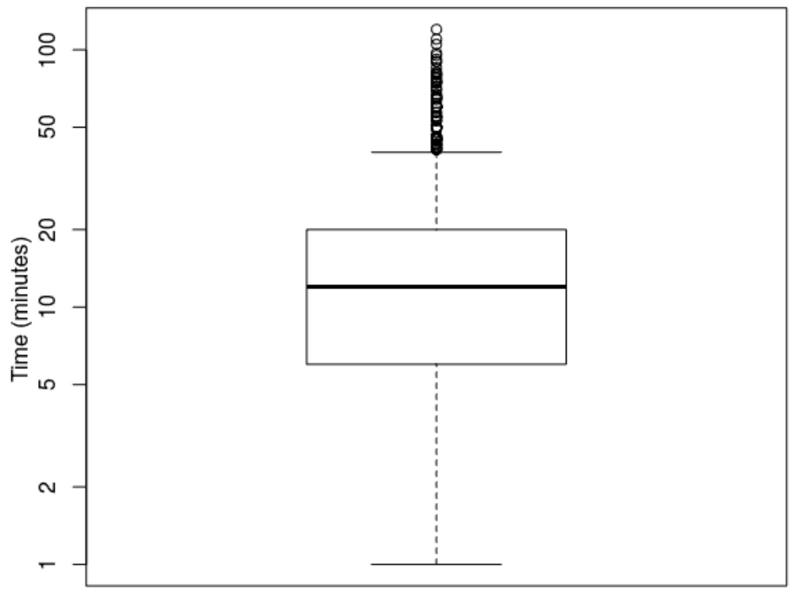

Figure 6. Home–school travel time.

3.1.4. Elements Found along the Route

Table 7 shows the frequencies obtained in the count of different elements present in the home–school trips. The values of the total percentages were calculated from the number of students who had specifically indicated using that mode of transport on their school trips.

Table 7. Elements found on home–school routes. (a) Wide sidewalks; (b) crosswalks; (c) lowered curbs; (d) elevated crosswalks; (e) traffic lights for pedestrians; (f) pedestrian streets; (g) green spaces; (h) bad condition roads; (i) road without sidewalk; (j) bad condition sidewalks; (k) bus shelter; (l) streets without sidewalks

Usual Means of Transport	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	Total
Walking	148	373	300	77	186	52	102	77	50	136	91	92	595
Car	131	455	337	176	376	62	137	132	130	125	195	150	803
School bus	45	191	168	113	145	9	67	116	155	63	154	126	399
Public bus	8	32	17	17	24	5	7	15	17	12	17	10	64
Bicycle	1	2	3	1	1	0	3	1	1	1	2	1	5
Motorbike	0	3	3	3	3	2	1	5	4	4	1	3	9
Other	1	5	2	3	3	0	0	3	3	1	1	1	8
Total	334	1061	830	390	738	130	317	349	360	342	461	383	1883
Total (%)	17.7	56.3	44.1	20.7	39.2	6.9	16.8	18.5	19.1	18.2	24.5	20.3	100

The most common elements were pedestrian crossings, with 56.3%, followed by lowered curbs, which were usually located at crosswalks, with 44.1%, and pedestrian traffic lights at crossings, with 39.2%. On the other hand, there were very few pedestrian-only streets in the areas of the schools participating in this project. Only 130 respondents, 6.9%, indicated that they used a pedestrian street to go to their school and only 16.8% confirmed that they used green areas. The problems in the condition of the roads, whether roads or sidewalks, as well as the lack of sidewalks or shoulders for a safe pedestrian route, reached percentages of around 20%, according to the participants. It was the school bus users who reported the worst road conditions, with sections in poor condition detected by 29.1% of the participants, and roads without shoulder or sidewalk indicated by 38.8%. Sidewalks in poor condition were most frequently reported by users who traveled on foot, with 22.9%.

To increase knowledge about pedestrian routes, the responses of students who usually walked were analyzed. Table 8 shows the number of adequate crosswalks, lowered curbs, pedestrian traffic signals, and pedestrian streets encountered in the walking routes of the students.

Table 8. Elements found on home–school routes for pedestrians.

Element	Found	Not Found	Total	Found (%)	Not Found (%)	Total (%)
Pedestrian crossings	373	222	595	62.7	37.3	100
Lowered curbs	300	295	595	50.4	49.6	100
Traffic lights for pedestrians	186	409	595	31.3	68.7	100
Pedestrian streets	52	543	595	8.7	91.3	100

The majority of respondents who walked to school, 373, felt that their pedestrian routes had adequate crosswalks and lowered curbs at intersections (300 positive responses). However, 543 pedestrians felt that more pedestrian streets were needed and 409 felt that pedestrian signals at intersections were lacking.

3.1.5. Means of Transport Preferred by Students

Figure 7 shows that the preferred mode of transport for the students was walking, with 446 votes (23.7%) followed by cycling, with 380 responses (21.9%). It is worth noting the low general preference for public transport by bus, with only 2.3% of the participants, being even lower in preferences than the train option, which is almost not used as a means of school travel in Galicia (Spain).

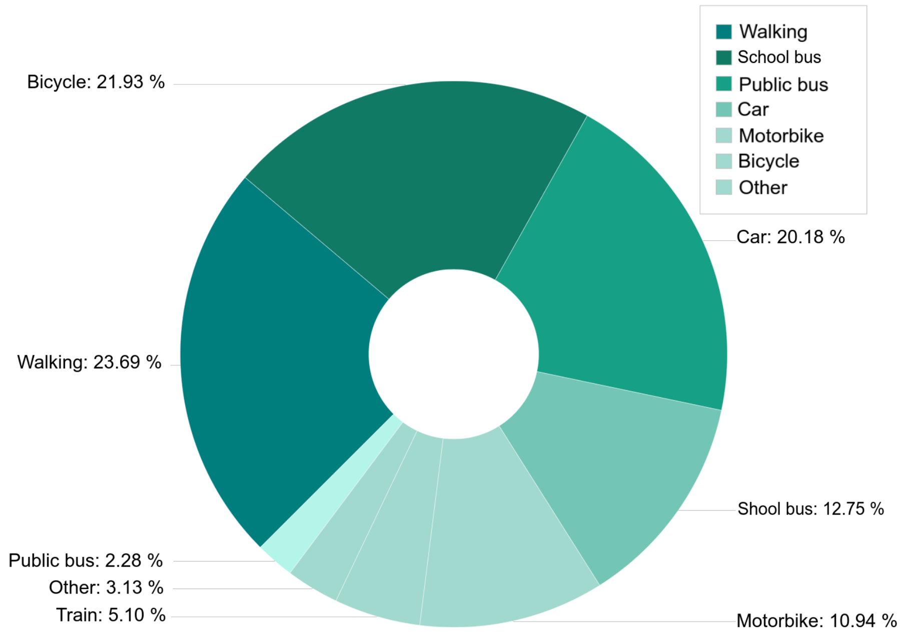

Figure 7. Means of transport preferred by students. The value refers to the total number of respondents (1883).

3.1.6. Reasons for Traveling by Car

Figure 8 shows the reasons why students chose the car as their usual mode of transportation. The most frequent reasons were bad weather with 830 votes, representing 44.1% of the respondents who selected this option, and spending less time commuting, with 647 students, or 34.4% of the total. The least common reason is to try to avoid risks, with only 126 responses (6.7%).

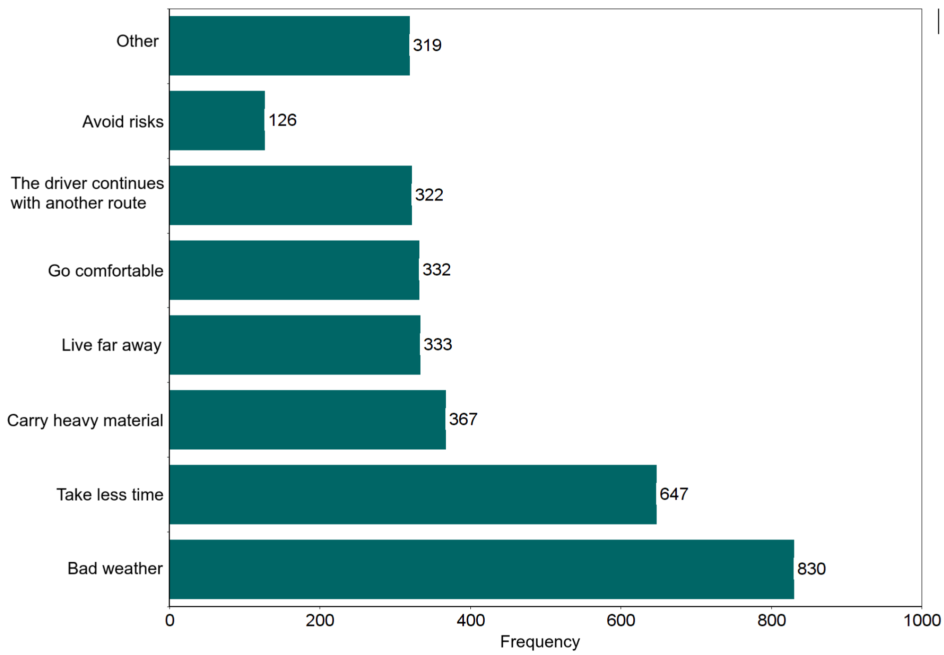

Figure 8. Student's preferred mode of transportation.

3.2. Travel Habits during Car Transportation

Table 9 shows the most frequent habits of students when traveling by car. The percentages refer to the total number of students surveyed. It can be seen that 73.4% use seat belts when traveling by car and 58.0% usually sit in the front passenger seat, compared to 40% who say they ride in the back seat.

Table 9. Student habits when traveling by car.

Habits	Frequency	%
Go passenger seat	1092	58.0
Go back seat	754	40.0
Use seat belt	1383	73.4
Use restraint chair	263	14.0

Since only 14.0% of the students used the child restraint seat and most of them sat in the front passenger seat, the behavior was analyzed according to their height. The results are shown in Table 10.

Table 10. Habits when traveling by car. A comparative study based on the height of the student. Percentages refer to the number of students with a height greater or less than 135 cm (1719 and 164, respectively). (a) Passenger seat; (b) no passenger seat; (c) back seat; (d) no back seat; (e) use child restraint seat; (f) no use child restraint seat; (g) use seat belt; (h) no use seat belt.

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
Height > 135 cm (Freq.)	1082	637	639	1080	142	1577	1277	442
Height > 135 cm (%)	62.9	37.1	37.2	62.8	8.3	91.7	74.3	25.4
Height < 135 cm (Freq.)	10	154	115	49	121	43	106	58
Height < 135 cm (%)	6.1	93.9	70.1	29.9	73.8	26.2	64.6	35.4

The results showed that, although children under 135 cm must sit in the back seat of the vehicle, only 70.1% confirmed that they did so. 6.1% confirmed that despite being less than 135 cm tall, they usually sit in the front passenger seat. In addition, 26.2% did not use the mandatory restraint seat according to [33]. Similarly, 25.7% of respondents taller than

135 cm stated that they did not use the mandatory seat belt and this percentage increased to 35.4% for respondents shorter than 135 cm. In fact, of the 803 students who used the car to go to school on the day of the survey, 181 (22.5%) decided not to select the option of using seat belts regularly in this question.

Reasons for Walking to School

Table 11 shows the reasons given by the students for walking to school. Most of the respondents (49.9%) said the main reason was to get physical exercise and 44.5% said it was to pollute less.

Table 11. Reasons to walk to school. Percentages refer to the number of students who walked to school on the day of the survey (595).

Motive	**265**	**%**
Pollute less	265	44.5
Do exercise	297	49.9
To be alone	85	14.3
To go with friends	203	34.1
Know the environment	93	15.6
To arrive before	85	14.3
To arrive clearer	157	26.4
For being older	139	23.4
Other	43	7.2

3.3. Geospatial Analysis

The correlation between the distances provided by the respondents through the mapping of their route to school and the distances obtained using the routing algorithm [30] was analyzed. For this purpose, Pearson's correlation coefficient was calculated using (3), obtaining a value of $r_{xy} = 0.988$.

$$r_{xy} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2}\sqrt{\sum_{i=1}^{n}(y_i - \bar{y})^2}} \quad (3)$$

In this study, x = distance given by the respondent, y = distance obtained by routing algorithm and n is the sample size (number of respondents). In addition, a linear regression analysis was performed (Figure 9), obtaining a coefficient of determination $R^2 = 0.976$, which shows a high correlation between both variables.

Because some of the routes drawn, despite having passed the basic control filter, still had significant simplifications in some parts of the route, we decided to use the routes calculated by the routing algorithm in the geospatial analysis. The results show that 781 students, 41.5% of the total, live less than 1 km from their school compared to only 1.0%, 19 students, who lived more than 20 km away. More than 35% of participating students lived more than 2 km away.

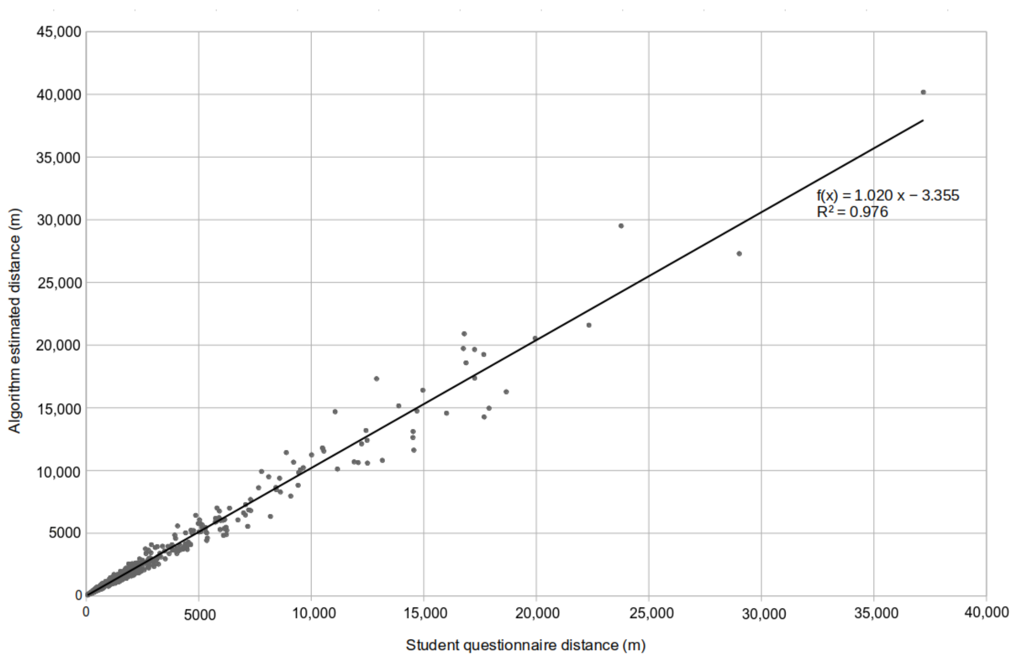

Figure 9. Linear regression analysis. Student questionnaire distance vs. algorithm estimated distance.

Figure 10 shows the number of homes located in the different zones of distance to the school.

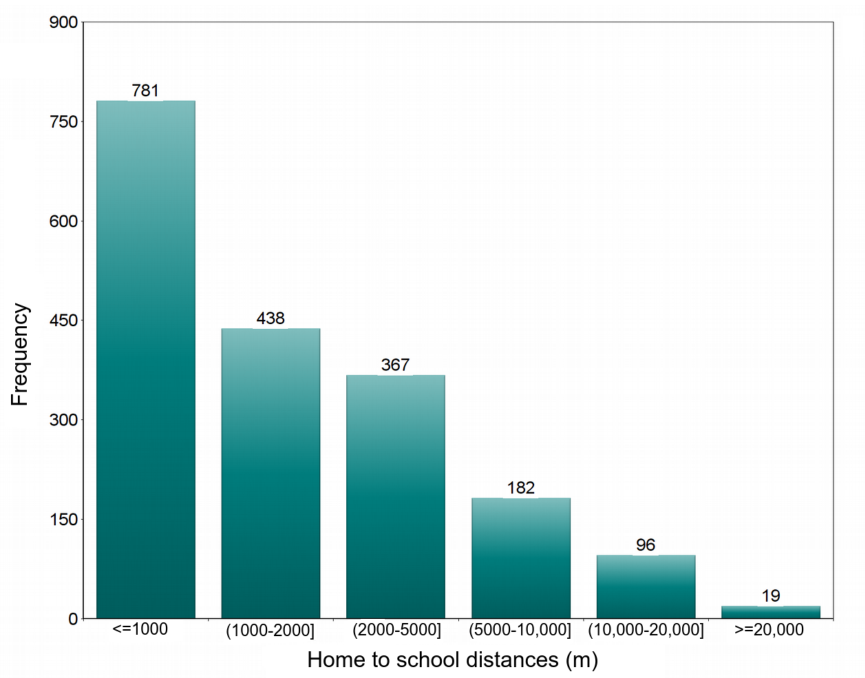

Figure 10. Number of homes located in each of the zones within the distance of the school.

Figure 11 shows the optimal home–school distances disaggregated according to the type of means of transport used. The results showed that students who traveled by public bus covered the greatest distances, followed by school bus users.

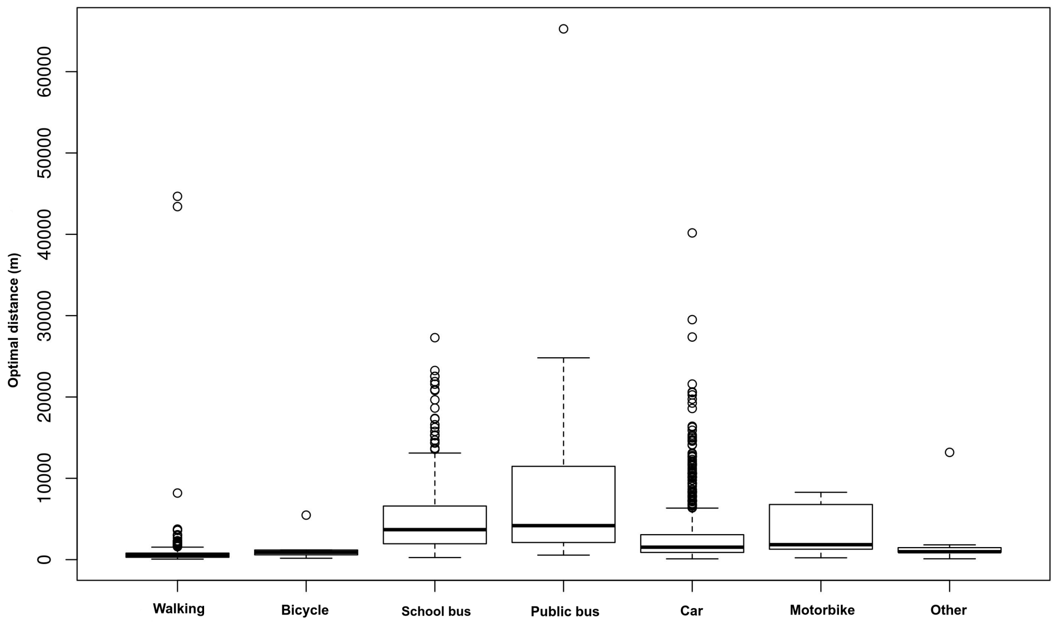

Figure 11. Home–school travel distances differentiated by means of transport.

Table 12 shows the result of the count of households by distance zones from the schools, calculated from the road network in the vicinity of each school.

Table 12. Household count in each distance zone. Separate survey for each school. Address count is shown in percentage values. Distances are shown in meters.

School	<= 400	(400, 750]	(750, 1000]	(1000, 2000]	>2000
CEIP A Gándara	10.0	30.0	20.0	25.0	15.0
CEIP A Solaina	30.4	39.1	13.3	8.7	8.7
CEIP de Laredo	20.6	50.0	14.7	7.4	7.4
CEIP de Piñeiros	8.7	34.8	43.5	13.0	0.0
CEIP Lopez FerA separate7.5	11.2	11.9	39.6	29.9	
CEIP de Zalaeta	23.8	45.2	11.9	9.5	9.5
CEIP Emilio Glez. López	16.9	4.6	1.5	20.0	56.9
CEIP Juan Rey	18.2	4.5	9.1	13.6	54.5
CEIP Pérez Viondi	15.0	35.0	15.0	15.0	20.0
CEIP Ponte de Xubia	32.7	18.4	22.4	12.2	14.3
CEIP Santa Baia	8.0	18.7	16.0	42.7	14.7
CEIP Virxe do Mar	27.1	20.0	9.4	28.2	15.3
CPR Ayala	39.4	20.2	0.0	23.1	17.3
CPR Jorge Juan	15.5	8.3	15.5	17.9	42.9
CPR Plurilingüe La Salle	6.9	7.8	6.0	32.8	46.6
CPR Santiago Apóstol	34.4	28.7	9.6	15.3	12.0
Escola de Domirón—CRA Narón	30.0	50.0	20.0	0.0	0.0
Escola do Val—CRA Narón	0.0	30.0	0.0	50.0	20.0
IES Agra de Raíces	0.4	10.5	15.0	15.8	58.3
IES Coruxo	8.9	7.6	11.4	17.7	54.4
IES de Foz	0.9	13.0	6.5	34.3	45.4
IES de Valga	0.0	3.6	6.4	29.3	60.7
IES Francisco Daviña Rey	0.0	4.3	13.0	34.8	47.8
IES Monte Castelo	14.8	26.2	11.5	34.4	13.1
IES O Mosteirón	0.0	4.1	0.0	10.2	85.7
IES Pluriligüe Maruxa Mallo	0.0	5.9	5.9	35.5	52.9
Total	14.0	16.9	10.6	23.3	35.3

Most of the students surveyed lived more than 1 km from their educational center, specifically 23.3% in the 1–2 km interval and 35.3% more than 2 km. This is mainly because many of these schools are located in rural areas and their students live in the nearest urban center, as is the case of IES O Mosteirón, where most of the students belong to the town of Sada, located approximately 4 km away. On the other hand, it was evident that the educational centers located in purely urban areas received students from a nearby environment, as can be seen in the CEIP of Laredo, CEIP of Zalaeta or CPR of Ayala, among others, where most of their students lived less than 750 m away.

Figure 12 shows several graphic examples of zoning by distance in sections of 400, 750, 1000 and 2000 m, corresponding to pedestrian travel times of 5, 10, 15 and 30 min. The density of homes per zone and the optimal road sections most frequently used by students are also shown, showing only those used by more than three students.

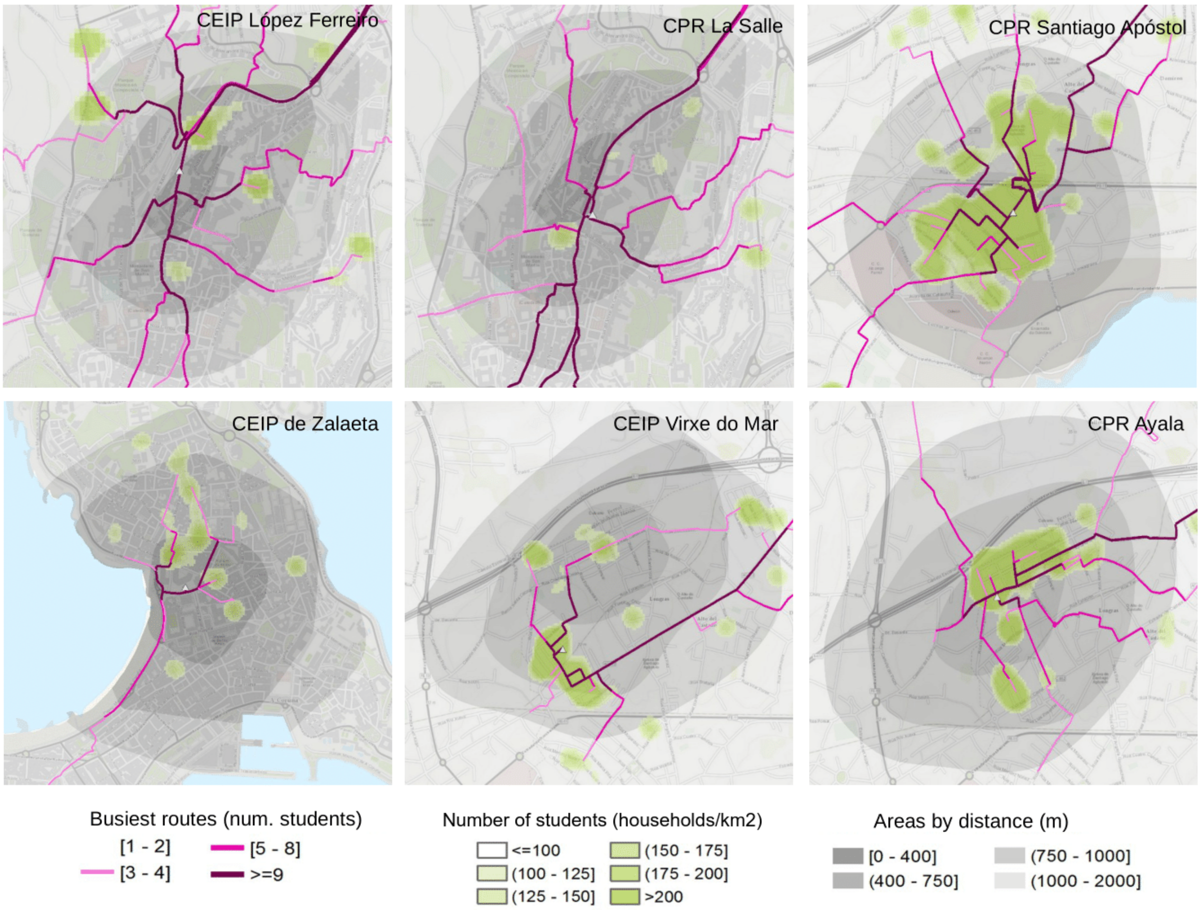

Figure 12. Analysis of optimal routes for an educational institution.

Finally, Figure 13 shows several examples, for the same schools as in the previous case, of the location of the problems identified by the students in their home–school routes.

Figure 13. Graphical representation of the problems identified by students on their daily home–school routes. Identification of problems given by number and optimal routes classified by number of users.

4. Discussion

To carry out this study, it was essential to develop specific functionalities on Emapic (https://emapic.es/ (accessed date: 28 August 2022)) to associate a geographic component to each question of the survey, which added value to the results. These improvements made it possible to generate a questionnaire on school mobility suitable for all ages thanks to a functionality that allowed participants to select for each question a response of varying complexity, according to the age of the students. In this way, younger students were able to answer the questionnaire in a straightforward manner, and older students or those with greater interest in the subject had the possibility of providing additional and more precise information to the study.

It was observed that the most difficult questions for the students were those related to the location of certain elements on the map, especially when they had to draw the route from home to the educational center, which was correctly digitized by 31.0% of the respondents. This value is relatively low; however, considering that it was the first time that many of the participants used editing tools on a map, and in a web system, it can be considered adequate. It is worth noting that the centers that had personal support from a member of the project team achieved more accurate answers, with significant differences being noted especially in the questions that involved a geographic component.

After analyzing the responses, the results show that the most common means of travel were via car, used mainly in rural areas, and walking. These results agree with those obtained in other studies such as [35] or [3]. Some of the reasons that justify the frequent use of car as transport include the usual rainy weather in Galicia and the need to carry heavy school materials, also found in [35], while students who usually walk do so motivated by physical exercise and by producing less environmental pollution. The time taken to travel was the issue that most concerned the respondents. Most students took

20 min or less to reach school grounds. There is a widespread belief that walking is slow; however, according to the results obtained, it was found that the fastest trips were those made on foot and by car. It was also observed that the combination of different means of transport is quite widespread among the population analyzed, with the most common connection being the school bus in conjunction with car transport. Although the car was the most used means of transport, the students responded that they would prefer to travel on foot or by bicycle if they had the opportunity to choose their transport. This result is surprising since only 29 of the 1883 respondents indicated bicycles as their usual means of transportation, being used preferably for recreational purposes. On the other hand, the low preference shown for the public bus is remarkable, representing only 2% of the participants.

Traffic and traffic jams are important factors when assessing the value of commuting to school, especially in urban environments. Most students who travel by car or public bus suffer from traffic jams caused by the poor flow of vehicles and a large number of badly parked or double-parked cars, a common habit in the vicinity of schools at school start and finish times. Pedestrians and cyclists also suffer regularly from the invasion of sidewalks or bike lanes by cars, which forces them to avoid them, sometimes having to do so by joining the road. On the other hand, bicycles were the least appreciated, and users of this type of transport were the ones who rated the journey least highly, with only 5.6% of the frequencies. Other mean of transport with the worst perception of travel was the public bus, although these results should be read with caution because this may be due to the low use of this means of transport by those surveyed. After all, only 5.5% of the students said they used this service. On the other hand, the school bus and walking were the most valued means of transport by users in terms of their overall perception of the journey, despite not being the fastest combination. Half of the respondents who walked and took the school bus indicated that their journeys were pleasant. Likewise, the motorcycle users regarded their trips as pleasant, although, on this occasion, the frequencies obtained were significantly lower.

Studies, such as [36], indicate that the age of the students marks the way they travel to school. In our study, we found that in early ages it was the parents, followed by the grandparents, who usually accompanied children to school, while in advanced courses they usually went alone or with friends, establishing 2hd Secondary Education as the educational level that marks a turning point between both habits. The objective of multiple municipal programs is to promote the autonomy of students on these routes since in addition to promoting child autonomy, it is possible to reduce pollution and the risks caused by the vehicles that come every morning to take children to school [37].

The most common elements found on the routes were pedestrian crossings, lowered curbs (closely related to crosswalks), and pedestrian traffic lights at intersections, elements that expedite and provide safety for pedestrians. However, in agreement with [38], the lack of pedestrian-only streets and green areas, which with a large number of narrow sidewalks, were a source of dissatisfaction on the part of pedestrians, stood out.

All students, regardless of the means of transport used to get to school, must walk at least a small part of their journey, so it is important to know how they behave on these trips. According to results, approximately 62% walked on the sidewalk, 47% looked at both sides of the road before crossing it and 40% crossed at the established crosswalks. These values were too low to refer to issues that should be mandatory, so they should be studied in greater depth in future studies, to influence and encourage more appropriate behaviors. Likewise, more than half of the school bus users did not expect it at the bus shelter, so the reason for this should also be analyzed.

Regarding habits during car journeys, only 73% of the students always fastened their seat belts, and, of those under 135 cm, 70% sat in the back seat of the vehicle and 26% did not use the child restraint seat. These data are worrying, as the participating students did not freely select issues that should be fundamental habits for road safety.

Finally, it was observed that, although the average school travel distance in the sample analyzed was 2593 m (a greater distance than that found in other studies such as [39], where the average distance was 1623 m), the majority lived less than 1 km from their school, 16% of whom lived between 400 and 750 m away. These distances are feasible for daily walking and cycling, as shown in [34]. Even with these distances, the private vehicle was the most commonly used mode of transport.

5. Conclusions

In this study, we proposed an analysis of school accessibility based on data acquired through a web system of geolocated surveys, Emapic (https://emapic.es/ (accessed date: 28 August 2022)). This subsequently allowed us to add a spatial component to any type of information captured through an online questionnaire. For this purpose, several specific developments were made to obtain a battery of valid questions to be answered by different student profiles, regardless of their age. One of the main weaknesses encountered during the process was that the questions related to the identification and drawing of geographical features on the map were overly complicated for some of the students surveyed. Some school house routes or the specific location of certain problem areas were not correctly located or not answered, forcing the use of routes obtained through a routing algorithm [30] instead of being able to directly use those obtained in the survey for the pedestrian accessibility analysis. It was also found that the accuracy of the surveys increased significantly when students were tutored by a subject matter expert who guided them through the questionnaire response process, rather than being guided by a teacher or answering the questionnaire autonomously.

Although the preferred means of transport for the students were cycling and walking, most home–school trips were undertaken by car and walking in urban environments, and only a minority used a bicycle as a means of travel, using it only for recreational use, regardless of student age and the environment in which they live: urban or rural. Proof of this was that most of the students surveyed lived less than 1 km from the school in urban environments, distances accessible to most pedestrians and cyclists and, despite this, the majority of trips were made by private vehicle. The reasons given by the students were mainly to avoid bad weather and the need to carry heavy school materials.

It is worth highlighting the habits of students when making their journeys, both on foot and by car, since although most of them complied with the established road traffic regulations, approximately a quarter of those surveyed did not use seat belts, child-restraint seats for children under 135 cm, or crossed the street without looking both ways and without using the obligatory pedestrian crossings. Finally, the usefulness of Emapic (https://emapic.es/ (accessed date: 28 August 2022)) as a tool for acquiring thematic data with associated geographic information has been demonstrated. The acquired data are very useful for application across multiple studies, such as school mobility studies, as described in this work. Regarding future lines of research, it would be of great interest to analyze all schools within the same city to assess the school routes comprehensively, analyzing the sections of greatest interest for each school. The data obtained would be essential for the schools themselves in order to manage their school routes more efficiently. We are also working on identifying patterns of responses based on the geographic location of participants to locate trends associated with socioeconomic, demographic, or urban characteristics of the areas where respondents reside. In addition, we would like to enhance Emapic (https://emapic.es/ (accessed date: 28 August 2022)) so that it can also be used to add thematic information to studies on the characterization of pedestrian routes and the generation of more efficient pedestrian accessibility models.

Author Contributions: Conceptualization, David Fernández-Arango and Francisco-Alberto Varela-García; methodology, David Fernández-Arango and Francisco-Alberto Varela-García; software, Jorge López-Fernández; validation, David Fernández-Arango and Francisco-Alberto Varela-García; formal analysis, David Fernández-Arango and Francisco-Alberto Varela-García; investigation, David Fernández-Arango and Francisco-Alberto Varela-García; writing—original draft preparation, David Fernández-Arango and Francisco-Alberto Varela-García; writing—review and editing, David Fernández-Arango and Francisco-Alberto Varela-García; supervision, Francisco-Alberto Varela-García; project ad-

ministration, Francisco-Alberto Varela-García; funding acquisition, Francisco-Alberto Varela-García. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Directorate-General for Traffic of Spain, grant number SPIP2015-01867.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The Emapic code can be viewed and downloaded at Github-Emapic (https://github.com/Emapic/emapic accessed date: 28 August 2022). Aggregate data on participation in mobility surveys, as well as the methods and results associated with this work can be found on the project website at Geomove (https://cartolab.udc.es/geomove/ accessed date: 28 August 2022).

Acknowledgments: This research was funded by the Directorate-General for Traffic of Spain through the Dynamic study of school mobility using geolocation web technologies (SPIP2015-01867) project. We would like to especially express our gratitude to the staff of CartoLAB (UDC) (https://cartolab.udc.es/), GAC-CITIUS (https://citius.usc.es/ accessed date: 28 August 2022) and DeustoTech (https://deustotech.deusto.es/ accessed date: 28 August 2022) for their collaboration in this research.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Structure of Geomove database. Schools registration questionnaire.

Nr	Field Name	Data Type	Possible Values	Mandatory	Description
1	gid	Integer		Computed field	Numerical identifier unique for each school registration.
2	geom	Geometry (point)		Yes	Location (coordinates) of the school.
3	precision	Integer		Computed field	Precision of the automatic geolocation process used by the user. (It will be empty if no geolocation process was used.)
4	province_gid	Integer		Computed field	The numerical identifier of the province this school belongs to according to its location.
5	municipality_gid	Integer		Computed field	The numerical identifier of the municipality this school belongs to according to its location.
6	timestamp	Date/Time		Computed field	The date and time the registration was submitted.
7	nombre_col	Text		Yes	Name of the school.
8	tipo_col	Option from list	Public /Private /Charter	Yes	Type of school.
9	nr_alumnos	Integer		Yes	Number of students the school currently has.
10	nr_profesores	Integer		Yes	Number of teachers the school currently has.
11	nr_otros_trab	Integer		Yes	Number of other workers the school currently has.
12	nivel_educ_inf	Yes/No		Yes	Whether the school offers child education.
13	nivel_educ_pri	Yes/No		Yes	Whether the school offers primary education.
14	nivel_educ_sec	Yes/No		Yes	Whether the school offers secondary education.
15	nivel_educ_bach	Yes/No		Yes	Whether the school offers high school education.
16	nivel_educ_fp	Yes/No		Yes	Whether the school offers vocational training.
17	nivel_educ_otro	Text		No	Text describing other types of education offered by the school.
18	nombre_contacto	Text		Yes	Name of the contact person for the school.
19	email_contacto	Text		No	E-mail of the contact person for the school.
20	telf_contacto	Text		Yes	Phone number of the contact person for the school.
21	comentarios	Text		No	Any additional comments regarding Geomove or their registration the person wants to provide.
22	Clave	Text		Computed field	Password assigned to the school for identification purposes.

The full structure of the main questionnaire database, that gathers the mobility data from students is available online at Geomove database structure (https://cartolab.udc.es/geomove/datos-desarrollos/main_survey.pdf accessed date: 28 August 2022).

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