

GEOGRAPHIC EDUCATION AND SPATIAL CITIZENSHIP: COLLABORATIVE MAPPING FOR LEARNING THE LOCAL ENVIRONMENT IN A GLOBAL CONTEXT.

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Abstract: This work recapitulates the foundations and didactic principles of geography teaching by means of resources based on Geographic Information Technologies and geoinformation, but specifically in the examples of collaborative cartography at different scales, as these present the necessary actions to respond to the need to improve digital competencies and increase the adoption of digital education methodologies. Through its implementation in the Geography Teacher Training Master's Program for Secondary Education, but also in the schools involved in the internships, the digital literacy of teachers and students has been developed in a comprehensive manner through the use of collaborative mapping. Digital literacy is implemented by the use of Geographic Information Technologies (GIT), in such a way that five competence skills are developed: (i) instrumental; (ii) cognitive-intellectual; (iii) socio-communicational; (iv) axiological and (v) emotional.

The ultimate goal of this pedagogical approach is the acquisition of (digital) spatial citizenship capable of facing current challenges, and promoting local changes, with the purpose of making global impacts.

Keywords: TPACK; geographical competences, digital competences, geoinformation; democratic participation, spatial citizenship.

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1. Introduction

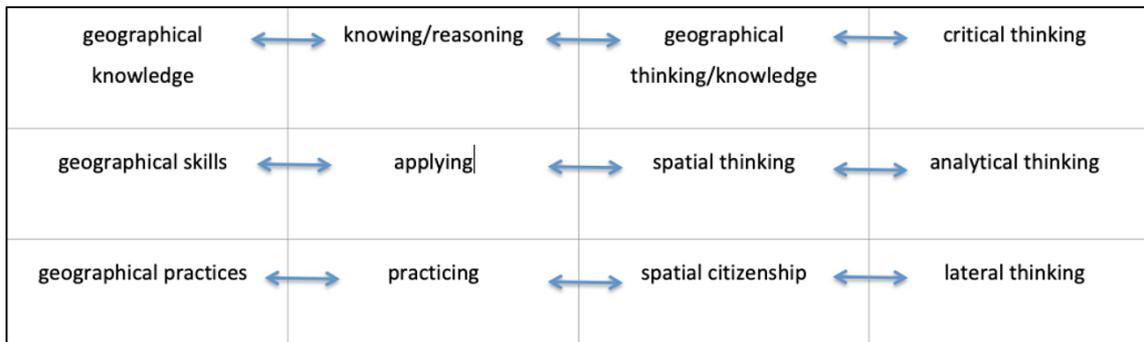
During the last two years, the measures taken to combat COVID-19 helped us to verify, that there is a significant gap in digital literacy issues in the countries of the European Union. Education and training systems around the world were affected and stressed like never before by this pandemic, which has radically changed the way we learn, teach, communicate and collaborate in our education and training communities and between them. This fact had repercussions on students, their families, teachers, trainers, school management and society in general. It is promoting a transformation in education, activating the use of online information and forcing us to reflect on teaching tasks from a completely new perspective. And also we discovered new opportunities in this process: tools and methodologies that can improve learning and motivation or new directions of advance in our field of research.

Therefore, at an educational level, we can talk about the role of the pandemic as an accelerator of trends, with changes in the contents and in the way of doing science and teaching. During these two years we have attended to an effort in collaboration and a truly unprecedented volume of scientific-educational information exchange. Not only the most immediate obstacle such as the mobility restrictions imposed by the confinement was possible to overcome by online collaboration tools, but also the limitations in resources and capacities inherent to small groups of educators. In this context, Geography has acquired special relevance since the pandemic has caused an increase in the demand for geoinformation -statistical and cartographic- by society, registered both in access to specific web portals, and in monitoring and interactions of socio-geographic profiles in social networks. All of this is accompanied by an encouragement of spatial citizenship, both at the level of the country and of the European Union.

In such circumstances, Geography and in particular geographic education are essential in the current paradigm of global change and sustainable development, since they are the disciplines that provide us with knowledge about society and the territory at all educational levels. In addition, in this area the technologies (particularly geospatial technologies, Geographic Information System (GIS), digital atlases, remote sensing, geolocation-based mobile apps, etc.) have had great impact on innovative learning and educational benefits: didactic resources, pedagogies, inquiry, problem-based learning, learning and service, etc.

In this way, we can affirm that geography is an essential subject for the consolidation of spatial citizenship and digital literacy, as indicated by several recent studies (Georgeson and Maslin 2018; Liverman 2018; Nightingale 2018; Sultana 2018; Fu 2018). At the same time, the transversal approach to understand and combat this crisis requires good learning of school geography for the sake of digital geographic education that advocates change, as shown by both previous international works (De Miguel and Sebastian 2022; Sebastian and De Miguel 2022) as examples of good practices in European digital geographic education (Sprenger and Nienaber 2018; De Lázaro et al. 2020; Jeronen 2020), but especially for the setting of an integrated framework of geographical competences for international curriculum and assessment (De Miguel 2021).

Table 1. Integrated framework of geographical competences for international curriculum and assessment. (De Miguel, 2021)



However, it should be noted that, even though this process of democratization and use of geospatial technologies and open data has increased exponentially in the last two years during the pandemic, we have also been able to verify that there is a significant gap in matters of digital literacy in the countries of the European Union. Spain has also reopened the debate on educational renewal and the promotion of critical and democratic thinking through the efficient use of Information and Communication Technologies (ICT) and open data. This fact, at the same time, caused an increase in the demand for geo-information -both statistical and cartographic- by society, registered in the number of accesses to specific web portals, as well as in the monitoring and interactions of socio-geographical profiles in social networks. Nevertheless, are teachers capable of critical and reflexive use of this information? Are geographic educators prepared for this change?

2. Methodology

In order to answer these questions, a survey was designed whose objective was to measure the degree of digital skills of Geography teachers and their inclusion in their teaching praxis. This survey was sent to different middle and high schools -chartered and public schools- in Aragon (Spain). The sample size was n=136 teachers (with 96.3% specializing in Geography and History and 3.7% in Language and Social Studies). This sample is not homogeneous in terms of gender or age. In the case of the perception of their digital skills as citizens and teachers (Fig. 1), the obtained results were very high, since 88.2% of those surveyed considered that they had plenty of digital skills and that they could promote these skills in his students (80.9% of them answered in the affirmative way with arguments).

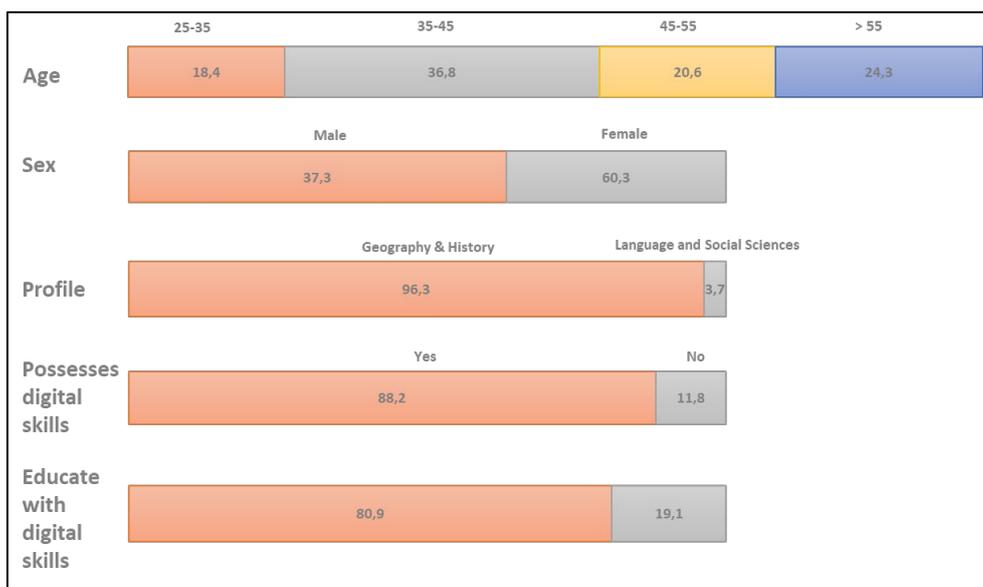


Fig 1. General data of the respondents and their perception of the degree of their digital skills as a citizen and adequacy of their teaching practice to promote them. Source: own elaboration

The measured aspects were (Mishra and Koehler 2006; Kampylis 2015; Gómez 2016; Drummond and Sweeney 2017; Mishra 2019; Hidalgo and Gisbert 2020); (i) degree of knowledge of the European and national reference frameworks to carry out the teaching project; (ii) use of reference standards to assess digital and Geography-specific skills (Fig. 2); (iii) use of the methodology that serves to acquire the geographic skills through the efficient use of GIS and geoinformation (Table 2).

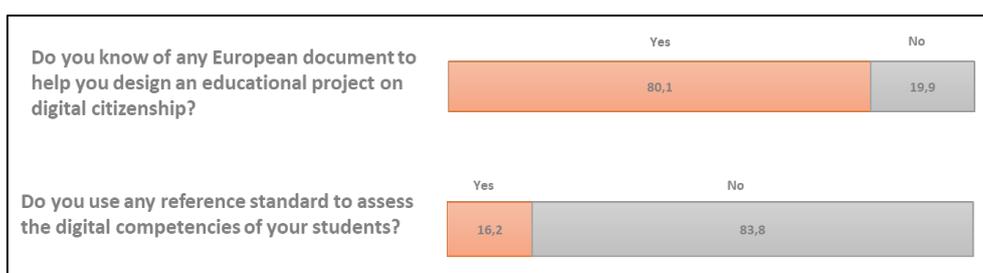


Fig. 2. Teachers' perception of knowledge of the European reference frameworks to address their teaching project and assess their students according to standards. Source: own elaboration

Table 1. Example of the most common responses on how teachers consider that the acquisition of specific and digital skills works in their subject. Source: own elaboration

Use of the computer and the mobile phone to carry out tasks, search for information, prepare documents...
Working with different programs, working with classroom, email...
Working with spreadsheets, using email and Classroom.

Interactive activities and programs like Edpuzzle, Genially, podcast, etc.
Realization of activities where the use of digital tools is mandatory.
Presentations, Internet searches, resolution of online questionnaires.
Knowledge of different specific programs of the module.
Search for information online, work on the subject or presentation.
Webquests, tasks and presentations. Using: Genially, Canva, Google docs, Drive...
Proposing different tasks where they must use the digital resources they consider appropriate.
Tasks, presentations, classroom management...
Treatment of information, creativity, understanding and synthesis through the use of instruments such as Canva, Issue, Google documents... Organization of work and promotion of autonomy using Classroom. Cooperative and collaborative using the named tools and others such as Genially, Google presentations, Padlet...
With ICT content.

Later, a series of didactic proposals were designed and implemented in different educational contexts. These proposals were mostly based on collaborative mapping, since it is an active learning approach that: (i) fosters the multi-causal explanation of spatial distributions and phenomena through an inquiry-based learning (Marrón 2011) ; (ii) increases the understanding of the spatial information and promotes the formulation of a working method and the subsequent presentation of geographic information (Souto 1998); (iii) helps to put into practice the interdisciplinarity of knowledge, not only to geographic education but also to education for citizenship or connectivism (De Lázaro et al. 2017) .

Last, a questionnaire was answered twice (pre- and post-test), in order to validate the collaborative mapping for the acquisition of digital skills in educators, this is, before and after the implementation of the didactic experiences that are using the TPACK teaching-learning model at two different competency scales: (i) one that is based on digital literacy; communication and collaboration; and another whose emphasis lies in (ii) digital content creation and problem solving.

In this way, an experimental design was used in both the quantitative and qualitative approaches using questionnaires created from instruments already developed for the TPACK model (Schmidt et al. 2009; Valtonen et al. 2019; Cabero and Llorente 2020; Cabero and Palacios 2020; Ortega and Gómez 2020). The questionnaires contained a first part of general identification and a second part that included closed, open and Likert-type questions (Cejas et al. 2016; Lopera et al. 2020), which corresponded to the self-perception of the types of knowledge of the TPACK model. PCK in the questions that are oriented to the application of various aspects of geographical thinking and spatial competence and TPK in the questions that are focused on the knowledge of the Geographical information technologies (GIT) and its application in the different educational contexts.

3. Case studies of didactic proposals for the promotion of digital citizenship

It is evident that Geography during the pandemic has had a certain advantage over other disciplines, since, as we have already seen, the use of geotechnologies in the classroom has proliferated exponentially in recent years (De Miguel 2019; Álvarez and De Lázaro 2018). However, the challenge of COVID-19 has forced teachers to reinvent themselves and to adapt not only to the need to acquire digital skills, but also to develop basic transversal skills in students (Carretero et al. 2018; Redecker 2017; Vuokari 2022), which are essential to the success of the educational process. Autonomy, critical vision and the capacity for self-learning stand out among these competences. In an educational context where daily contact in the classroom has been lost, these skills, together with work habits, self-regulation capacity, and self-discipline when tackling tasks, come to play a fundamental role.

In this context, it is really interesting to address an education that fosters spatial digital citizenship. Addressing the concept of citizenship implies establishing educational practices that develop critical and democratic thinking and promote the ability to interpret and evaluate information in each place (De Miguel 2021b). The didactic use of collaborative cartographies through web-GIS platforms, such as those presented in this article, involves training autonomous, efficient, responsible, critical and reflective citizens when selecting, processing and using information and its sources, as well as the different technological tools. It also entails having a critical and reflective attitude in the evaluation of the information available, contrasting when necessary. Finally, it promotes the participation of young people in the democratic system and integrates them as actors of change to improve their environment (living space) or to make their city's street map more equitable and egalitarian.

The following are two case studies that, as we have been able to verify during their practice and through the results of the pre-test and post-test survey, promote the acquisition of citizenship skills by the students, developing didactic strategies that allow them to be active citizens capable of fully participating in their communities and making intelligent decisions online and in life. In such a way that it can be affirmed that students can better and more reliably understand the political, economic, social and cultural complexity of the world in which they live, and thus be actors of the change postulated by 2030 Agenda.

3.1 Collaborative mapping of your living space during a pandemic (confinement period and immediately after) “My world in 15 minutes”

This initiative of the University of Zaragoza and the GEOT Chair of Territory, Society and Geographic Visualization aims to be a collective reflection experience that allows us to tell the story of our city during pandemic period. This didactic experience is part of other international works that debate about the necessary transformations of the urban world, focusing on the relationship between space and useful time, the urbanism chrono. Our hypothesis is: How did my living space change during the first months of COVID-19? What measures did we adopt as

citizens to be related with our space in a safe way? Do these new habits, taxes and others elements offer a serene city, with more proximity, less stress or less hours of transportation? In the same time, does it satisfy its essential urban social functions? It is about advancing as citizens to propose among all of us a deep transformation of the urban space (still highly monofunctional), towards a polycentric, sustainable city. City that allows increasing quality, easier access to the essential urban social functions such as inhabiting, work, stock up, take care of yourself, learn and rest.

This educational experience also tried to portray emotions. Emotions present the lived space, but also the perceived space (Lefebvre, 1974), and they are a transversal object for geography. Society emotionally interacts very differently with places, while territorial practices respond to personal and collective memory. Specifically, emotional mapping allows to understand how one perceives the space where the person is, how does one feel it, and how does one become familiar with it.

Objectives of this initiative were: (i) to experiment with collaborative mapping methodology; (ii) to map how we perceive the different spaces and routes that connect them, how we feel them, how we live them, and how they affect our behaviors and daily movements; (iii) to debate on how our “living space” has changed after the COVID-19 pandemic; (iv) to propose improvements in our day-to-day places to reduce our trips while still enjoying our city.

The urban space where we live our daily lives has been modified in the last years because of the COVID-19 pandemic. This modification takes the form of a reduction in the number of places we go to, in the reduction of the activities that are carried out and in the more intense use of the space near our centers of reference (residence, work, place of studies). Our life unfolded for several months in a small city, which we reached in 15 minutes. This, in the case of Zaragoza -about 700,000 inhabitants-, is good news, because it is a very compact city. People have discovered new places to walk, places that are pleasant to them, that are close to their home and that previously went unnoticed.

The tool used in this proposal is Collaborative Maps of the municipal website of the Zaragoza City Council. Maps are tools to understand the complexity of a territory, they are like photographs that portray geographic or, in this case, sociodemographic realities. Collaborative maps through digital platforms allow us to create these cartographies through collective action. Therefore, they are no longer static photographs of the city taken by a single author, but they are platforms opened for collective participation, being a result of citizens and their interrelation with the environment.

Within the Collaborative Maps section, there was a proposal of the development of three maps (Fig. 3):

(i) Living space: This map proposes geolocation of different spaces that we visit in our daily life: housing, working, shopping, walking, leisure, sports, facilities.

(ii) I change my house: This map aims to reflect where would you live if you could choose a place anywhere in the city?

(iii) What do I want nearby? This last map invites to debate about your nearest space, geolocating the proposed location of the equipment that any person would need to improve their living space.

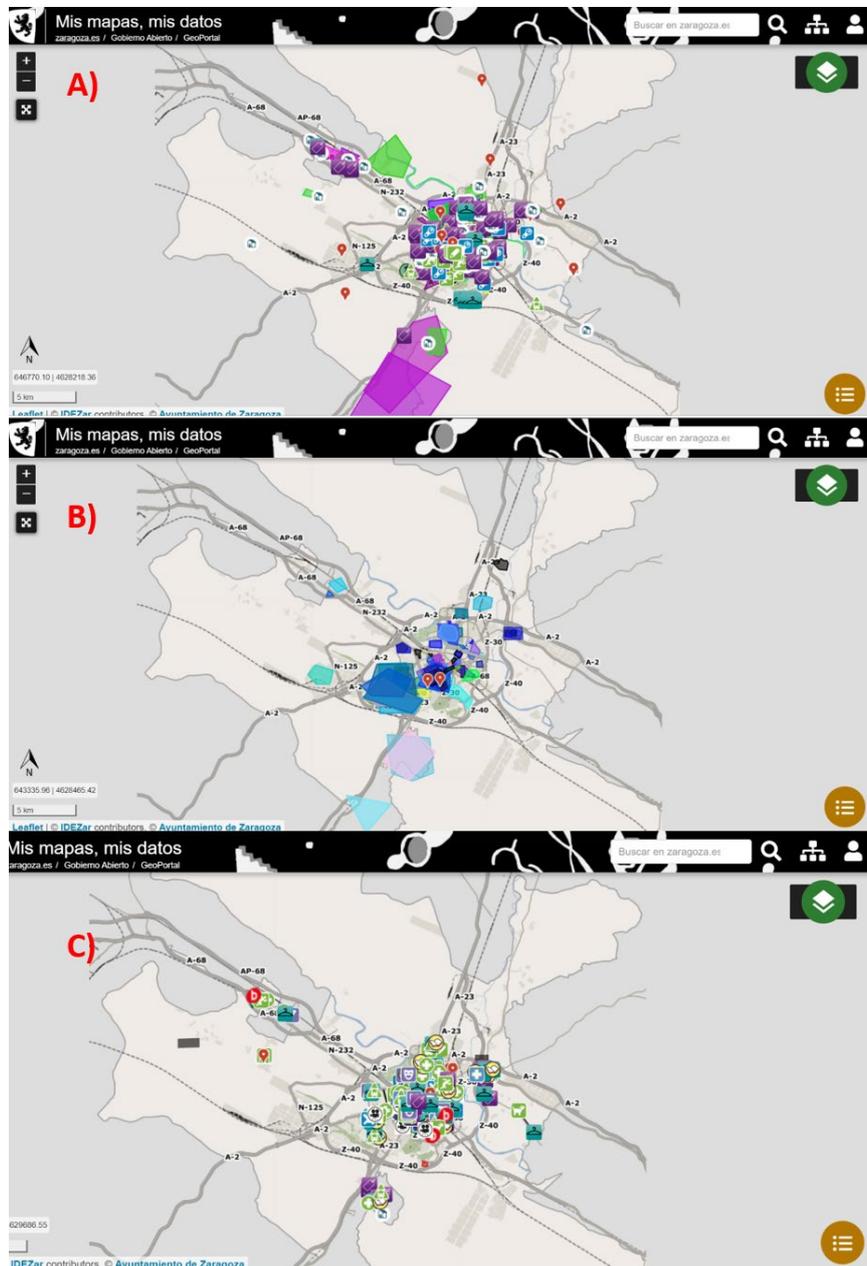


Fig. 3. Maps resulting from the collaborative mapping “My world in 15 minutes”: A) Cartography of the living space; B) I change house; C) What do I want near?. Source: own and collaborative elaboration

This proposal was initially implemented by students of a course in geographical education, teacher training in Primary School Undergraduate program, Faculty of Education. More than 150 people have participated in this initiative (including school children), so they mapped their

story and how they felt during the pandemic period of uncertainty. They also rethought the needs that they have as citizens and how to cover these needs. In short, they present in the map their story about what decisions they made to maintain proximity within the distance.

It seems clear that the society has to progress towards more habitable and sustainable cities, which offers more complete and nicer living spaces. Making citizens reflect on this, how they have reinterpreted and rediscovered their immediate environment, allows them to achieve a more sustainable city and, in turn, empowers them as citizens to ask for facilities and infrastructure that help achieve a more sustainable city for all.

3.2 Collaborative mapping of women's streets in Huesca

A joint initiative of the University of Zaragoza, together with the *Geochicas OSM* (GeoGirls Open Street Map) group (Sebastian et al. 2021), has been launched named Collaborative mapping of the streets with the name of a woman in Huesca. The experience was carried out in the Ramón y Cajal High School in Huesca during February and March of 2022. The participating groups belonged to the 3rd course of lower secondary education (14-year-old) that allowed us to broaden the spectrum of informants and the conclusions.

One of the groups was made up of students with learning difficulties or situations of difficult adaptation. We will call it A and it was made up of a total of 22 students, of whom three were repeaters, one student lived in a center for under 18 run by social service, but he stopped attending the center at the end of the course. One student suffered a process of bullying in the Primary school, one student who had recently joined the Spanish educational system and had serious language difficulties. Also a recently arrived Spanish-speaking student, one repeating student who had to attend to the class online due to medical prescription that forbids her to attend face-to-face classes and two students with recurring absences whose families were informed about it. In the same group, some negative situations about the experience were detected once it had started, and three students decided to not participate actively in the activity because of ideological reasons. The other group, which we will call B, has different characteristics, although their number was similar, 21 students. Composition of this class was more homogeneous.

There were 14 classes during which the experience was developed, distributed in subject of Social Sciences and Education for Citizenship which was taught by the teacher Lorenzo Mur. The summary of the methodological design is synthesized in following points:

(i) Introductory sessions to raise awareness of the problem in the classroom through an open debate where were presented questions of collective response and close approach. Some examples of these questions: What streets do you know in Huesca? Which ones do you think that are the most important? What places do you avoid to walk through and why? What professions do you think the mentioned names used to perform? Are you missing something?... While the debate was taking place, the most important conclusions were written down on the blackboard and a dialogue was established.

(ii) A second phase proposes the extension of the conclusions to other Spanish, European and American cities and presents the Geochicas project through its viewer. In this way, the students are brought closer to the reality of the nomenclature of our cities to see its masculinization and importance of different professions or activities: politicians, military, saints and virgins...

(iii) Collaborative mapping of the street map of Huesca - during this phase the students are divided in six groups, every one corresponding to one part of the administrative division of the Huesca map. For its correct development each group of students (students' voluntary composition) is assign to a part of the city where they have to extract the names of the streets and classify them generically into three groups: masculine, feminine and non-gender names. Together (using a shared file) they create an Excel sheet with the extracted data.

(iv) Edition and search for information on Wikipedia about the women presence in the Huesca street scene, noting the most relevant characteristics. In those cases, that had no entry in Wikipedia a biography would be proposed to fill this gap.

Once phases (c) and (d) were carried out, the results were analyzed and they verified an evident reality: the majority of Huesca's streets is based on male historical figures dedicated to politics or the military profession. The few examples of women refer mainly to virgins or nuns.

(v) Exhibition of the results of the previous processes and space for a reflection and awareness within a concept of an inclusive and sustainable urbanism where everyone feels represented. From students' initiatives, a consensus document emerged between both class-groups, A and B, which reflected their concerns.

(vi) Public exposure of the research process for its dissemination in the city and the claim for actions in search of a more equitable and sustainable street map. Finally, the educational experience had an important dissemination and impact in some interviews in local press, radios and tv channels. Geography students were able to express their citizen values in front of a wider audience, but also in front of the Huesca City Council.

Despite the work done in the search for information, the most important debate and conclusions were drawn once the map of Huesca could be viewed on the *Calles de las Mujeres* viewer (<https://geochicasosm.github.io/lascallesdelasmujeres/>). The map of the Streets of women of Huesca (Fig. 4) shows evidences: the majority of the Huesca street map is based on male historical figures dedicated to politics or the military profession. The few examples of women refer mainly to Virgins or religious life and represent 16% of streets named after relevant historical figures for the city.

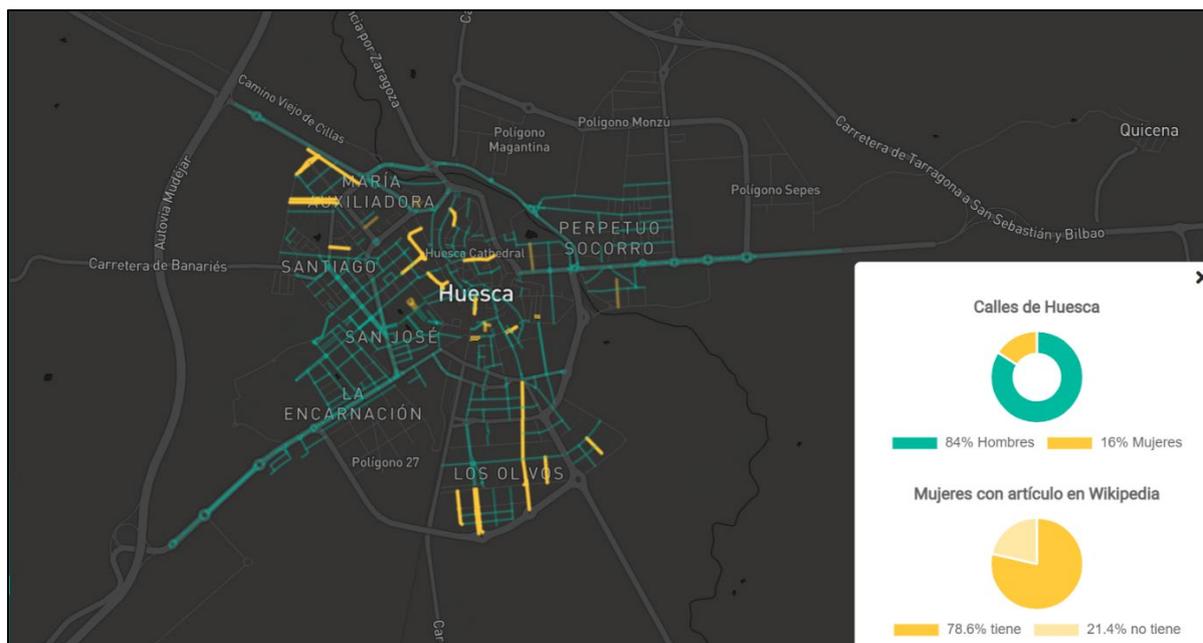


Fig. 4. Street map of Huesca on the viewer of the streets of women. Source: own and collaborative elaboration

This experience has shown that students understand and detect much better the terms of gender through cartography and spatial categories, in particular the street map of their city. In fact, through analysis and reflection of the map, similar conclusions were drawn in both groups: (i) awareness of the existence of a gender difference in the naming of the streets; (ii) historical origin of this disparity intensified in recent times and continues with the same discrimination (the last three new streets returned to follow the criteria of the 19th century); (iii) the need to redirect this situation, although there were opinions varying between the urgency of reversing the situation and resignation to this reality, which is waiting for a reflection of the authorities that would stop the perpetuation of this discrimination; (iv) need to propose solutions.

4. Results and discussion

Results of the methodological validation, in general, are positive, especially with regard to knowledge about the use of technological tools and resources. This includes the general understanding of how to apply them in a productive way at work and daily life, as well as the ability to recognize changes in the local built environment, so technological information facilitates the achievement of the objective of spatial citizenship learning. As it can be seen in Table 3, the results of the pre-test and pos-test show the students have a general positive perception, and also a slight improvement, after the instructional implementation, but presenting a relatively important variance (0.841 in the pretest and 0.878 in the posttest).

Table 3. Comparative summary of the pretest and posttest questions. Source: Own elaboration based on the answers obtained in the teacher validation questionnaire

	AVERAGE	MEDIAN	INTERQUARTILE RANGE	VARIANCE
Pretest knowledge	2,552	2,000	1,000	0.841
Posttest knowledge	2,768	3,000	1,000	0.878

This occurs especially when these teaching and learning processes are presented in particular contexts with proposals applied to specific pedagogical, technological and content problems simultaneously integrated, as it is the case of the proposals presented here. Also, a clear and positive trend has been observed in the development of the types of knowledge linked to ICT and digital skills, which greatly improve with the implementation of collaborative mapping, once specified and applied to the particular problem of teaching Geography.

However, along with these positive aspects, this study observes some difficulties and limitations related to the integration of digital skills in the teaching-learning processes. In the first place, and especially, there are divergences observed between teachers' self-perception of digital skills and the limitations in their open answers, since an important part of the sample confuses digital skills with ICT tools, and provides generic answers and not specific answers for the teaching of Geography.

All these elements show that the implementation of specific proposals based on the collaborative mapping model to develop digital citizenship opens an innovative and beneficial field of analysis; however, there still are many challenges. In addition, the evidence shows the need of a knowledge integration process to develop completely the sentiment and attitude of digital citizenship, considering the different types of knowledge (geographical, digital and citizen) but, above all, their integrations in a particular context that converts the students to actors of change. Although research must continue to explore the limitations and problems of the implementation of certain types of knowledge, the integrative proposal continues to be the way forward for teaching-learning processes in which ICT are every time more and more key resource both for teachers as well as for students.

5. Conclusions

Geography is an ancient scientific discipline, with an established body of knowledge, but it faces the challenges of a changing world, a technological revolution and the teaching of rapid political, economic, social and cultural transformations that impact space, countries and regions of the world, as we have seen with the COVID-19 pandemic.

Geographic education, and in particular geographic education for a digital citizenship, is committed to innovation and practices that respond to the challenges of the 21st century, including the fulfilment of the 2030 Agenda. In this sense, teaching geography involves the

design of didactic proposals that allow us to address cognitive domains related to knowing, applying and reasoning and to the acquisition of spatial thinking, geographic thinking and spatial citizenship, in order to develop analytical, critical and lateral thinking.

Collaborative mapping offers teachers and students a very interesting context to address all these competencies, as it allows the entire cognitive process for the analysis, visualization and interpretation of realities, while emphasizing students as active agents in both information gathering and subsequent decisions, empowering them to be agents of change on a local scale (mostly), but with global repercussions. This chapter shows that teaching geography must be re-visioned, taking advantage of the opportunities given by the spread of geotechnologies and the increasing methods for teaching collaboratively and online during pandemic, and promoting spatial citizenship education through collaborative mapping in which secondary school students are able to represent local contexts -as Zaragoza and Huesca- from the perspective of global challenges, like sustainable cities and communities or gender balance.

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