Centre for Research on Settlements and Urbanism

Journal of Settlements and Spatial Planning

Journal homepage: https://jssp.reviste.ubbcluj.ro

Developing a Holistic Strategy Based on GIS and Story Mapping for Learning and Communicating Geography

María Jesús GONZÁLEZ GONZÁLEZ*[1], Alfonso PISABARRO[1]

Corresponding author

[1] *University of León, Faculty of Philosophy and Letters, Department of Geography and Geology, León, SPAIN*

mjgong@unileon.es 0000-0002-3639-3446

apisp@unileon.es 0000-0002-7084-2508

DOI: https://doi.org/10.24193/JSSP.2024.2.03

Received: 15 May 2024

Received in revised form: 25 November 2024

Accepted for publication: 24 December 2024

Available online: 30 December 2024

Keywords: *story mapping, ArcGIS, land planning, collaborative work, urban development*

ABSTRACT

The Geographic Information System (GIS) offers a vast array of applications, tools, techniques, and digital resources in geographic science, including digital cartography, remote sensing, virtual globes and web viewers. Recently, these technologies have gained prominence due to their high scientific and educational value. They provide an ideal platform for digital learning and for fostering curricular and methodological innovation in Geography education, with significant potential for independent distance learning. Based on practical activities and student satisfaction surveys, this paper demonstrates that modern GIS tools and story mapping are powerful mechanisms for understanding geographic and land-planning concepts. They also provide a more engaging and pedagogical way to communicate a holistic vision of the world. The results show an increase in student motivation and an improvement in space skills. The findings highlight that innovative methods for sharing visually georeferenced and geographic content can significantly enhance the teaching and learning experience connected with real-world problems.

1. INTRODUCTION

Education plays a pivotal role in enabling students and teachers to transition from traditional methods to modern pedagogical approaches that integrate technology into teaching and everyday life. To prepare young individuals for future challenges, it is crucial to adopt teaching strategies that are dynamic and aligned with societal needs (Santana-Tavera, 2022).

Modern education demands that teachers adapt to the evolving requirements of the 21st century learners, particularly given the rapid advancement of technological resources (Palazón et al., 2011). These advancements have revolutionized learning by making it more visual, interactive, and engaging, thereby increasing student motivation and interest (Gómez-Trigueros, 2016a).

Geography, as a discipline, provides insights into the spatial organization of society and the temporal evolution of human and environmental interactions, being, at the same time, linked to communication (Díaz-García et al., 2020). Integrating technology into teaching through tools such as ArcGIS Online and story mapping offers educators an effective way to explain complex subjects. Not only do these tools complement traditional fieldwork, but also enable the development of cooperative and interactive learning techniques. GIS

and story mapping allow students to explore the educational potential of spaces where interaction occurs, enhance their imagination, and cultivate independent critical thinking. Moreover, these technologies empower students to address real-world problems while fostering their personal and academic growth.

Since the 20th century, the growth and adoption of GIS techniques in geographic research and applied disciplines have been significant (Bosque et al., 2012). It is now crucial to demonstrate how cooperative methodologies and associative study techniques linked to GIS can spark students' interest in Geography and land planning at all educational levels. Resources such as geography games and online visual content offer accessible and engaging ways to achieve this. The role of GIS in land planning has evolved considerably with recent technological advancements and practical applications. It is no longer limited to cartographic representation and has become an essential tool for analysing, simulating, and optimizing various aspects of urban and territorial planning (Deng and Wu, 2022).

This paper aims to demonstrate how interactive GIS techniques and story mapping can serve as effective mechanisms for understanding contemporary geographic and planning challenges while providing a more pedagogical approach to communicating a holistic vision of the world (González-González and Pereira-Pérez, 2016).

2. THEORY AND METHODOLOGY

2.1. GIS as a foundation for teaching Geography and Territorial Planning

In traditional learning, knowledge and reasoning were two different things. To develop the faculties of learning, people first had to be taught to develop their powers of reasoning (Bao et al., 2009). As such, it was impossible to acquire knowledge without reasoning it beforehand. Resolving different situations can, in turn, help us find solutions to other problems (Vasconcelos Santillan, 2015).

Educational innovation must be based on problem-solving, bearing in mind the uniqueness of each situation. These solutions cannot be used for any situation in which unexpected events occur (Delacôte, 1998). The conceptualisation of Geographic Information Systems (GIS) has evolved as an interdisciplinary field combining geography, computer science, and social sciences to analyse and manage spatial data.

GIS are fundamental techniques in territorial planning, enabling geospatial data to be collected, organised, analysed and visualised accurately and efficiently. This integrated approach facilitates informed decision-making in various contexts, ranging from urban planning and land management to environmental governance and socio-economic impact assessments.

In general terms, GIS can be defined as systems designed to capture, store, manipulate, analyse, manage, and present data related to positions on the Earth's surface (Longley et al., 2015). Their ability to integrate spatial and non-spatial data on a digital platform makes them particularly useful in planning, where understanding spatial relationships and underlying patterns in data is essential. GIS are used for land use analysis, transport modelling and infrastructure design. They allow the visualisation of urban expansion, the identification of critical areas for development and the evaluation of the impact of urban policies (Batty, 2017).

Moreover, GIS are essential for monitoring ecosystems, assessing natural disaster risks and planning natural resource conservation. For instance, overlaying vegetation maps with climate data can be used to identify areas that are vulnerable to climate change (Burrough and McDonnell, 1998). Optimal zones for economic, residential or recreational activities can be identified using GIS, based on variables such as resource access, topography or road connectivity (Clarke, 2001). They also aid in locating facilities such as hospitals, schools, and transport networks to maximise coverage and reduce costs (Goodchild, 2009). GIS offer significant advantages in planning, such as: Interactive Visualization, which allows real-time data interaction; Advanced Spatial Analysis, which supports scenario modelling, proximity analysis, and multi-criteria evaluation; and Data Integration, which consolidates data from diverse sources including satellite images and sensors. GIS enable 3D Visualization to assess the impact of development projects and zoning policies, fostering collaboration between planners and decision-makers. Tools like urban expansion simulators help forecast city growth and evaluate the social and environmental effects of different development options. Additionally, the integration of IoT devices and sensors allows real-time monitoring of urban infrastructure, enhancing management and supporting data-driven decisions. GIS also play a key role in addressing urban heat islands and deforestation by providing predictive analyses to guide mitigation efforts.

Moreover, they promote citizen participation through accessible applications that improve transparency and decision-making. Technological advancements, such as AI for automated satellite image analysis and open-source tools like the Urban Planning Toolbox, further broaden access to cutting-edge technologies (Esri, 2023; BID, 2023; MappingGIS, 2024). However, GIS also face challenges, including the need for skilled personnel, high implementation costs, and issues with data accuracy (Heywood et al., 2011). Rapid continuous progress in communications technology is changing teaching methods. Educational

innovation must be based on solving problems in unique situations. General solutions cannot be applied in situations where unexpected events occur (Delacôte, 1998). Over two decades ago, it was established that information and communication technologies (ICT) would revolutionise teaching (Guerra-Santana et al., 2019).

Nowadays, virtual environments, augmented reality, or artificial intelligence have evolved so quickly that it is not easy for teachers to adapt their digital skills to the changing educational paradigm. ICT must work in a virtual environment with "learning pills", that is, stored audio-visual information that can be consulted and put into practice (Santana-Tavera, 2022). Used appropriately, these tools successfully motivate students to learn in an active way.

Moreover, they also represent a new educational dimension that makes teaching a much easier task (Martí-Parreño et al., 2021). For this to be achieved, other education agents need to be more flexible and put the resources into practice (Salas, 2007). Thought must be given to how to phase out traditional methods and introduce new techniques. Teachers and students can provide better solutions based on their knowledge of problems and experience in solving them using new technologies. Their greater self-confidence and self-determination will thus provide innovative solutions (Delacôte, 1998).

2.2. Interactive mapping and its educational potential

The interactive map is a web map that users can manipulate to change the style or format, zoom, search, filter, or view pop-ups (Esri, 2023). In a highly technological world, the implementation of information and communication technologies in the teaching and learning process is essential. Technological transformation implies a change in teaching methods, where the student becomes an active agent in the learning process and the teacher, an essential guide to achieve objectives (Buzo, 2016). As Gómez-Trigueros (2016b) highlights, effective integration of technology in education enables a shift from the traditional model - in which teachers are the sole providers of knowledge and students are passive learners - to a more dynamic approach that aligns with the needs of the Information Society. In the new model, students take a more active role in their learning, while teachers focus on mentoring and supporting them. This shift is essential for preparing students for the challenges of the 21st century. This paper proposes using tools such as ArcGIS Online and story maps to explore case studies, helping students identify and compare global issues. These tools are accessible to all students, either for free or through institutional access, and allow for the creation of interactive maps that represent the development of cities or other geographic phenomena. By visualizing data in this way, students can engage with complex concepts more easily and find the learning process more attractive and motivating especially in a time when reliance solely on books and articles no longer captures the students' interest effectively.

Adopting such technologies fosters the acquisition of key competencies including digital literacy and independent learning, making them integral to modern education. Two case studies illustrate their potential, as it shall be further described. The first case study involves subjects related to urban planning, which, like other subjects, allows the introduction of geoinformation techniques such as Geographic Information Systems (GIS) (Miguel González, 2014). The software to be analysed as an instrument for teaching urban planning is available to at everyone, free of charge or through university access. This program enables the geographic location of historical events by creating maps with overlapping geolocated layers that contain the information to be taught in the classroom.

The second case study goes one step further by considering skills acquired by students in GIS in previous years and attempting to orientate their work towards applicability and interactivity on mobile devices and to communicate successfully in an interconnected world. It is essential to introduce collaborative methods that go beyond the classroom and the use of static mapping to understand spatial relationships including interactive geospatial tools. Until now, efforts entailed in producing maps using GIS since the '90s, as well as written work, have been forgotten in the teacher's drawer, without being revised and improved by other students. The same has occurred with map displays and geographic analyses produced by individuals and small groups. The second case study therefore adapts to communicating results in a way that responds to current needs, where working on the web and the opportunity to learn online is becoming widespread.

By integrating ArcGIS Online and story maps into the classroom, educators can introduce interactive visualizations to explore global challenges and facilitate comparisons. These tools have already used in teaching general geography (Guallart-Moreno, 2016; Miguel González et al., 2016; Walshe, 2016; Koloshyn et al., 2019) but their use in specific subjects has not been explored in depth. For instance, in Urban Planning and Development, a case study could involve using *story maps* to explore the urbanization process in specific cities, where students can examine historical maps, population growth, and infrastructure development. This could be used to study sustainable development practices or urban challenges in real-time and in collaborative projects that use collective mapping (Velilla-Gil et al., 2021). This method enhances learning

by encouraging students to work together while addressing contemporary educational needs.

2.3. Collaborative work as a method of consolidating learning

Online GIS tools increase the possibilities of collaborative work. A map can be available for different accounts working together. The methodology based on collaborative work aims to stimulate continuous learning bearing in mind the characteristics of each individual student. Nowadays, many interpersonal relationships are established through technology, developing new codes and regulations which, when applied to cooperative work, produce completely new results. Emerging educational projects are increasingly based on socialization and the construction of relationships between students. This provides a basis for teaching the knowledge and skills required to address any conflicts that may arise (Echeita, 2012). Cooperative learning stimulates intelligence and cognitive skills in students, regardless of their individual psychological characteristics (Salas, 2007). It also enables interdependence that encourages students to combine their efforts to reach objectives. Teachers should set clear assignments and students must understand that they all need to work together to complete them, each putting in the same effort. All students are responsible for their own work and that of the group. To put cooperative teaching into practice, it must depart from traditional teaching methods based on "individuality", "homogeneity" and "passiveness" (Kagan and Kagan, 2009). As such, cooperative learning has put an end to all these concepts as it involves working together to reach a common goal and is, therefore, an adequate method to be included in ICT (Choi, 2021). In subjects where the cooperative methodology is applied, students must ensure that the results of their fellow students are beneficial for the whole group (Johnson et al., 1994). This type of learning contrasts with the competitive type in which they compete to reach objectives such as high grades. By applying this methodology, students do not only learn academic content, but they also develop cognitive skills and improve their interaction with teachers and fellow students. It is essential to be able to put these skills into practice whenever necessary (Domingo, 2008). Finally, it is also essential to be clear about the positive and negative effects of cooperative learning, which were synthesized in Table 1.

Table 1. Advantages and disadvantages of cooperative learning methods.

	Advantages	Disadvantages
	Effects on personal and social development	
For students	- increased self-esteem when developing cognitive and social skills; - development of interest in learning by interacting within the group; - expectations of success based on the success of the group; - mastering communication in an efficient and appropriate way; - a more positive attitude towards others, fomenting respect, tolerance, trust and empathy; - learning how to act effectively in a group; - developing a sense of responsibility towards others; - integration of students with learning difficulties.	- different academic levels and spaces for work can be a problem; - some students may develop marked individualistic attitudes.
For teachers	- it promotes flexibility and creativity in teaching, enabling them to provide incentives and observe; - a program linking academic, personal and social objectives can be presented; - active learning is encouraged; - self-esteem is developed; - it encourages the learning of a language; - interpersonal relationships are improved and a better atmosphere in the classroom is created; - it responds to the needs of classes with different learning capacities.	- teachers do not know how to use the methodology; - it is difficult to find a fair method of evaluation for everyone in the group; - lack of support from school teaching staff; - parents' mentality can have a negative impact; - a series of resources and ITC are necessary to make the method more efficient.

Source: Gómez-Gutiérrez (2007) with modifications.

3. RESULTS

3.1. Activity for learning urban development through GIS

The activity involves designing a new educational facility based on the urban development plan and population forecasts for a specific neighbourhood. Each student conducts an in-depth analysis of a city in Castilla y León region as part of the Urban Planning course in the third year of the Geography and Territorial Planning bachelor programme. The objective is to identify the current classification of municipal land and determine the most

suitable location for the new education facility. This analysis requires evaluating future city growth and the need for additional educational infrastructure to meet urban development requirements. The activity is designed to align with course objectives and foster digital literacy with cartography playing a central role in improving the visualization and quality of research findings.

Before starting, students address key questions such as identifying areas in need of a new educational centre and the reasons behind these needs, analysing which youth population segments require primary or secondary education, evaluating proximity to existing schools, and assessing the potential impact of population growth if no school is built in a specific area (Fig. 1).

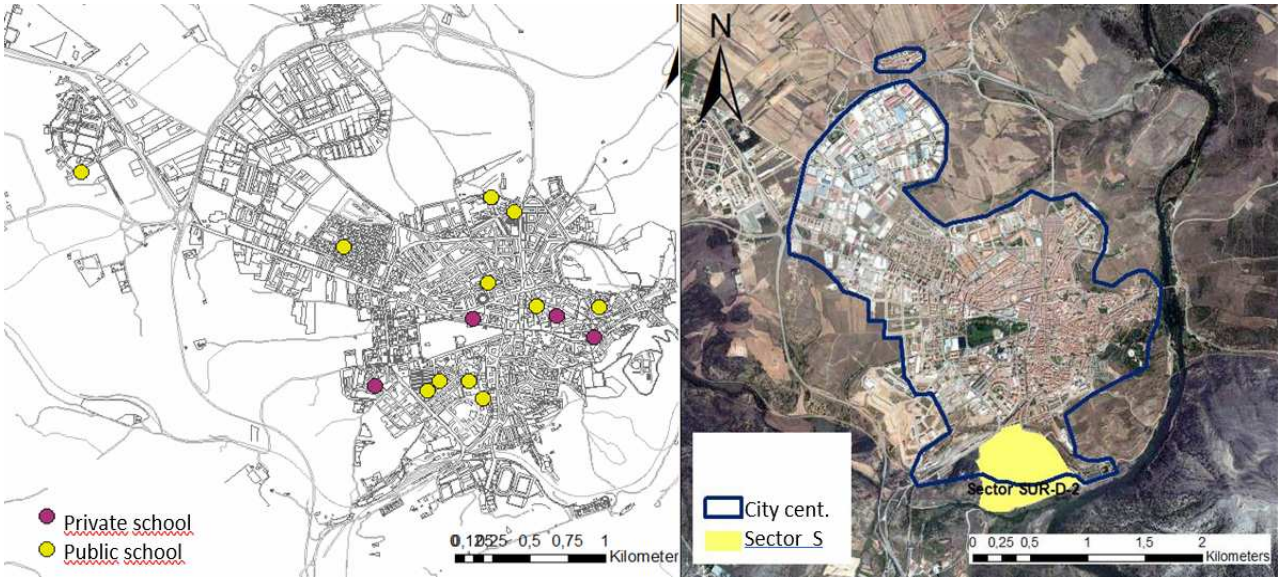

Fig. 1. Left - Private and public schools in Soria. *Source: authors' own work, based on information from the Castilla y León Regional Government Education Department (Junta de Castilla y León, 2024a).* Right - City centre. SUR-D-2 sector.

As a case study, the city of Soria, with its population of approximately 40.000, serves as a practical example. Soria's economy relies predominantly on the tertiary sector, with minimal presence of secondary industries such as agro-food and wood production within its municipal area. The analysis is carried out through bibliographic research, reviewing articles, books, and publications, alongside current urban legislation.

The city's urban development follows the General Urban Development Plan (GUDP) (Ayuntamiento de Soria, 2024), approved in 2006, which ensures comprehensive urban management. The GUDP is a comprehensive urban planning instrument required in Spanish cities with populations exceeding 20.000. It classifies land into urban, urbanisable, and non-urbanisable categories and outlines guidelines for community infrastructure, including educational facilities, libraries, and administrative buildings.

Information on educational facilities is sourced from Castilla y León's public database, which includes school characteristics and a geo-location tool. Mapping tools like ArcGIS software, the Spanish Geospatial Data Portal (IDEE) (Gobierno de España, 2024), the Castilla y León Information System (SITCYL), and the SIUCyL viewer (Junta de Castilla y León, 2024b; 2024c) are used to create detailed maps and geo-referenced data to support the study. These resources enhance the quality of the analysis by improving the visualization of findings.

Students begin by analysing the current number and distribution of primary and secondary schools in the city, locating and geo-referencing them using GIS tools. In Soria, urban expansion is limited by natural barriers such as the Duero River to the east, making southern sectors, specifically SUR-D-2, the most viable areas for development. The GUDP identifies this sector as critical for urban growth and the establishment of new facilities.

The analysis includes the evaluation of urban and demographic data to determine educational infrastructure needs. This involves assessing forecasts from the Provincial Board of Education (Junta de Castilla y León, 2024d), which may recommend expanding existing schools, relocating facilities, or reserving land for new educational centres or related infrastructure. Students synthesize their findings into story maps, integrating visualizations and proposing actionable solutions.

Students dedicate approximately four hours to the activity, focusing on tasks such as mapping existing schools, analysing GUDP guidelines, and conducting demographic assessments. They work autonomously but are supported by teachers through virtual workshops, resource-sharing *via* e-learning web platform, and collective discussions to address questions and analyse results.

Assessment includes self-evaluation, where students review teacher feedback provided through the Moodle platform. Teachers monitor progress, identify

difficulties, and offer targeted guidance. The activity is designed to adapt to online or hybrid learning environments, with resources available in digital and printed formats. All tools employed in this case are open-access, and accommodations are made for students with special needs, including simplified tasks and user-friendly GIS applications, for example ArcGIS online.

3.2. Activity for interactive maps using ArcGIS Online story maps

The activity, entitled "Regions in the World with Relevant Geographic Features", was conducted with third-year students enrolled on the Planning and World Regional Geography course, which is part of the Geography and Territorial Planning study programme. The primary objective was to transform a traditional paper-based assignment in Regional Geography into an interactive and engaging format. This approach encouraged students to explore the subject in greater depth, leveraging digital mapping tools and the vast availability of audio-visual materials.

Fig. 2. Story map about European deindustrialization and emerging countries with GDP web map and film. *Source: own material elaborated with gross domestic property map in ArcGIS Online, Shangai harbour satellite image from Google Earth and Los Lunes al Sol Spanish film trailer (León de Aranoa, 2002).*

Students were prompted to consider questions such as whether areas could be explored through satellite imagery, aerial navigation, or urban routes using Google Street View. They also examined the possibility of integrating interactive maps displaying variables such as GDP, population, or import-export balances, and whether expert video explanations could enhance their understanding of these regions.

Each student presented their work in class, following the traditional structure of introduction, development, conclusions, sources, and bibliography. However, they were required to incorporate an

interactive map featuring geo-referenced layers of geographic information, which they either created or edited themselves. During their presentations, students navigated through the application interface, exploring various locations and scales (see Fig. 2), which showcases a Story Map on the repopulation of the Scottish Highlands. They were also encouraged to enrich their presentations with multimedia content, such as videos and embedded material, including live data visualization tools like those provided by the National Institute for Statistics (INE).

This innovative approach to Regional Geography offers significant educational benefits for teacher training. It allows educators to closely monitor students' progress step by step, and provides them with tools to organize information in dynamic and engaging ways. Features including videos, embedded content, and chronological timelines make these tools useful for both student projects and teaching purposes.

Students benefit from autonomous learning as they receive continuous feedback throughout the construction of their Story Maps. Their work is shared online, allowing both the teacher and their peers to review and comment on it, fostering collaboration and improvement in real time. Recent advancements in data visualization techniques, such as interactive tables, maps, and graphs, have greatly expanded their application across various fields, including education. Online newspapers i.e. eldiario.es (2024), have showcased such tools in their data processing departments, providing excellent examples of how they can enhance the presentation and analysis of statistical information. These innovations underscore the potential of interactive mapping and multimedia tools in transforming traditional educational practices into dynamic, student-centred learning experiences.

3.3. Students' feedback

With the aim of assessing the degree of satisfaction of the students and the potential of the methodology, a survey was created using the Likert scale with a score range from 1 to 5. The questions asked explore, in addition to satisfaction, the suitability of the tool for the development of the course, both in the presentation practices carried out by the students and in the delivery of the theory by the professor. They also aim to indicate whether students would feel capable of sharing the results of their work publicly, i.e., on social media.

Student feedback was analysed with the aim of evaluating the extent to which the above has been achieved through the two proposed activities. Although the group of students surveyed was small, only four (a, b, c, d), it provides an indication of the strengths and weaknesses of the pilot project (Table 2).

Table 2. Results of the survey on satisfaction with the pilot test in both subjects.

Questions	a	b	c	d	Mean
Difficulties with use of ArcGIS Online	3	1	3	2	2.25
Have you been able to express your ideas in a better way?	4	1	3	3	2.75
Have you designed maps and added them to the "story map"?	5	1	5	4	3.75
Has it been easier to present your work than using Power Point?	2	1	3	1	1.75
Do you think your work is presented in a more attractive way?	4	1	2	3	2.50
Will you share your work in the future?	1	1	2	1	1.25
Will you use ArcGIS Online again even though it is not compulsory?	4	3	4	2	3.25
Will you use "story maps" in the future if it is not compulsory?	4	3	2	1	2.50
Have you used bibliographical references and sources in your work?	4	4	4	1	3.25
If somebody knows about your work, have they shown interest?	1	1	4	4	2.50
Do you think it will be of interest in the future?	3	1	4	4	3.00
Have you found this work more motivating than other types of tasks?	3	3	5	3	3.50
Do you think that ArcGIS provides adequate technical support for the subject of Urban Planning?	4	4	4	3	4.00
Do you think ArcGIS provides adequate technical support for the subject of World Regional Geography?	4	5	3	4	4.00
Have you shown your work to anyone *via* the open public link?	2	0	5	5	3.00
Have you shared it on any social network?	0	0	0	0	0.00

4. DISCUSSION

The results of the survey on satisfaction with the pilot project applied to Urban Planning and Regional Geography of the World indicate both positive and negative aspects. On the positive side, the students highlighted that the program was adapted well to subjects, increased motivation, and showed potential for use in the future. On the negative side, they clearly found it difficult to use and spent little time trying to learn as this was not the main objective of the subject. As a result, they did not produce work good enough to share with others. Teaching with ArcGIS Online Story Maps has provided a positive experience in enhancing

the students' general knowledge of Geography. The ability to interact with maps at different scales, such as Google Earth and aerial orthophotos, along with comparison tools and theoretical content, is highly effective in helping students link geographical concepts to the real world. Learning Geography and Territorial Planning is presented as one of the best ways to make students aware of the world in which they live and to understand the different processes that have led us to the present, as well as to carry out planning in an appropriate manner. Over time, Geography has become an increasingly complex discipline. Progress made in this science has demonstrated that geographical knowledge implies the understanding of multiple variables that interact with one another, i.e. spatial dynamics, land use planning, and sustainable development. Nevertheless, factors that hinder the process of learning Geography make this a difficult task. Geography, considered to be a social science, requires space vision, which represents a major barrier when learning the subject. To overcome these barriers, it is essential to change the method of teaching Geography, and this is where the implementation of the retrospective and global approach comes into play, with the help of new technologies and applications. GIS represent an essential tool in modern planning, given their potential to transform large data volumes into actionable information for decision-making. These applications demonstrate how GIS is transforming planning into a more sustainable, participatory and data-driven approach, contributing to improved quality of life in communities.

Like other sciences, Geography also enables the student to learn through experimenting and field work. The fundamental elements of geographical knowledge are space and time (Prats, 2017). Therefore, the proposed methodology using ArcGIS Online and story mapping is needed in order to understand certain phenomena and processes such as planning.

Taking into account the changes in social sciences, Postmodernism in the 1970s and 1980s led to the abandonment of synthesis and more emphasis was placed on the use of case studies, which made it easier to study the heterogeneity of a territory and the multidimensional complexity of reality and its plurality of perspectives when addressing it (Fazio-Vengoa, 2009). One of the greatest advantages of studying Geography from this perspective, together with the retrospective method, is the capacity to compare past and present processes in different geographical spaces. As a result, great progress can be made in learning about and understanding time and space, both key elements in this subject.

5. CONCLUSIONS

This proposal seeks to integrate university students into interactive online learning and therefore engage them in their own learning process and increase motivation. A strategy of applied Geography is developed, in which the focus is on solving real problems, thus achieving better results than those obtained with traditional methods. Students will see this subject as a useful instrument in their education, discovering how the present has been shaped and how it can be improved. This is essential for Geography to be considered an aspect that can make citizens aware of how the real world works. A more objective understanding of the globalised world in which we live is also promoted. To put all of this into practice, digital, collaborative and story mapping act as a fundamental tool because they succeed in involving university students in their own learning process, wherein motivation is an essential element. The pilot study indicates that this is possible with a small group and prior training on the tool before its use in subjects where it was not typically used. However, it is necessary to expand the research with more students and larger groups. While technology in the classroom enhances students' predisposition to learn, thus obtaining better results than in the case of employing traditional methods, skill integration enables the assessment of competencies. Traditional competencies can be fulfilled by properly developing any of the practices exemplified in the field of urban planning or regional geographic studies. The use of ArcGIS Online and story mapping has proven to be an excellent instrument in teaching Geography. This resource is a very effective way of instilling in students a global vision of processes in space that can occur in a specific area. The interaction can be saved in the cloud formatting for future reference, to be used as support material and updated when necessary. It could also be included in existing curricula and teaching plans as a specific competency. Therefore, this article is considered a support for greater utilization of these types of tools and techniques, both in applied geography and general geography.

6. ACKNOWLEDGEMENTS

Thanks are due to Teaching Innovation Project 2021: ArcGIS Online and story maps. Interactive cooperative support in student work, open to society and based on map information. Universidad de León; and Teaching Innovation Project (289). Training for teachers of Geography and related sciences in online teaching based on Geographic Information Technology (Tecnologías de la Información Geográfica (DIDGEOTIG) Universidad Complutense de Madrid.

REFERENCES

Ayuntamiento de Soria (2024), Plan General de Ordenación Urbana (General Urban Development Plan). URL: https://www.soria.es/es/ciudad/plan-

general-de-ordenacion-urbana-pgou. Accessed on 14.11.2024

Batty M. (2017), The new science of cities. MIT Press. Cambridge. ISBN: 978-026253456-7

Bao L., Fang K., Cai T., Wang J., Yang L., Cui L., Han J., Ding L., Luo Y. (2009), Learning of Content Knowledge and Development of Scientific Reasoning Ability: A Cross Culture Comparison. American Journal of Physics, 77(12), 1118-1123. DOI: https://doi.org/10.1119/1.2976334

BID (2023), Aplicaciones Digitales para el Urbanismo (Digital Applications for Urbanism). URL: https://www.iadb.org/es/quienes-somos/topicos/desarrollo-urbano-y-vivienda/aplicaciones-digitales-para-el-urbanismo. Accessed on 14.11.2024

Burrough P. A., McDonnell R. A. (1998), Principles of Geographical Information Systems. Oxford University Press. ISBN:9780198233657

Buzó I. (2016), Aplicación de la metodología del aprendizaje geográfico por descubrimiento basado en SIG en proyectos didácticos para 2º de Bachillerato (Application of the methodology of geographic discovery learning based on GIS in educational projects for 2º Bachillerato grade). In: La investigación e innovación en la enseñanza de la Geografía (Research and innovation in Teaching Geography). Universidad de Alicante, Alicante, 477-489. [Book in Spanish]. ISBN 978-84-16724-07-9

Bosque I., Fernández C., Martin-Forero L., Pérez E. (2012), Los Sistemas dInformación Geográfica y la Investigación en Ciencias Humanas y Sociales (Geographic Information Systems and Research in the Humanities and Social Sciences) Confederación Española de Centros de Estudios Locales (CSIC), Madrid. [Book in Spanish]. ISBN 978-84-615-9825-0.

Choi Y. (2021), Geography Achievement and Opportunity to Learn: A Focus on Computer and Educational Technology. Journal of Geography, 120(6), 232-238. DOI: 10.1080/00221341.2021.2000010

Clarke K. C. (2001), Getting Started with Geographic Information Systems. Prentice Hall. New Jersey. ISBN 0132947862.

Delacôte G. (1998), Enseñar y aprender con nuevos métodos: Una revolución cultural de la electrónica (Teaching and learning with new methods: A cultural revolution of electronics). Gedisa. Madrid. [Book in Spanish]. ISBN 84-7432-633-8

Deng Y., Wu C. (2022), Application of GIS in Urban Planning Information System. International Journal of Geographical Information Science, 36(4), 789-805. DOI: https://doi.org/10.1080/13658816.2022.2041234

Díaz-García I., Almerich G., Suárez-Rodríguez J., Orellana N. (2020), La relación entre las competencias TIC, el uso de las TIC y los enfoques de aprendizaje en alumnado universitario de educación (The relationship between ICT skills, the use of ICT and learning approaches in university education students). Revista de Investigación Educativa, 38(2), 549-566. [Article in Spanish]. DOI: http://dx.doi.org/10.6018/rie.409371

Domingo J. (2008), El aprendizaje cooperativo (Cooperative Learning). Cuadernos de Trabajo Social, 21, 231-246. [Article in Spanish]. https://revistas.ucm.es/index.php/cuts/article/view/cuts0808110231a

Echeita G. (2012), El aprendizaje cooperativo al servicio de una educación de calidad. Cooperar para aprender y aprender a cooperar. En Torrego, J. C., Negro, A. (coords) Aprendizaje cooperativo en las aulas: Fundamentos y recursos para su implantación (Cooperative learning in the classroom: Fundamentals and resources for its implementation). 21-45. Alianza. Madrid. [Book in Spanish]. ISBN 978-8420669618

Eldiario.es (2024), Eldiario.es Datos (data). URL: https://www.eldiario.es/temas/eldiario-es-datos/

Esri (2023), Soluciones SIG para planificación comunitaria (GIS Solutions for Community Planning). Madrid: Esri. URL: https://www.esri.com/es-es/industries/urban-community-planning/overview

Fazio-Vengoa H. (2009), La historia global y su conveniencia para el estudio del pasado y del presente (Global history and its suitability for the study of the past and present). Historia Crítica, (Extra 1), 300-319. [Article in Spanish]. URL: https://revistas.uniandes.edu.co/index.php/hiscrit/article/view/4167

Gobierno de España (2024), Infraestructura de Datos Espaciales (Spanish Geospatial Data Portal) (IDEE). URL: https://datos.gob.es/en/blog/spatial-data-infrastructure-spain-idee-benchmark-geospatial-information?utm_source=chatgpt.com. Accessed on 14.11.2024

Gómez-Gutiérrez, J. L. (2007), Aprendizaje cooperativo: Metodología didáctica para la escuela inclusiva (Cooperative Learning: A Didactic Methodology for Inclusive Schools). CCS-ICCE. Madrid. [Book in Spanish]. ISBN 978-84-8316-907-7.

Gómez-Trigueros I. M. (2016a), Innovaciones metodológicas en docencia universitaria: Resultados de investigación (Methodological innovations in university teaching: Research results). Instituto de Ciencias de la Educación, Universidad de Alicante, Alicante, 839-849. [Article in Spanish]. URL: http://hdl.handle.net/10045/54450

Gómez-Trigueros I. M. (2016b), Los campos de concentración de la II Guerra Mundial con Google Earth: Un recurso tecnológico para aprender y enseñar historia (World War II concentration camps with Google Earth: A technological resource to learn and teach history). History and History Teaching, 42. [Article in Spanish]. URL: http://hdl.handle.net/10045/65811

González-González M. J., Pereira-Pérez I. (2016), Los sistemas de información geográfica en la docencia y la investigación (Geographic Information Systems in Teaching and Research). In Alanís Falantes, L. et al., (cords), Nativos digitales y geografía en el siglo XXI (Digital natives in the 21st century) 575- 588. CSIC-Universidad Pablo Olavide, Sevilla. [Book in Spanish]. ISBN 97978-84-944193-7-9. DOI: http://dx.doi.org/10.14198/2016-nativos-digitales-y-geografia

Goodchild M. F. (2009), Geographic information systems and science. Wiley. New Jersey. ISBN 978-0470870013

Guallart-Moreno C. (2016), Aprender Geografía con ArcGIS Online. En Sebastiá Alcaraz R; Tonda Monllor E.M. (Eds.). La investigación e innovación en la enseñanza de la Geografía. (Research and innovation in teaching Geography). San Vicente del Raspeig: Universidad de Alicante, 575-589. [Article in Spanish]. ISBN 978-84-16724-07-9. DOI: http://dx.doi.org/10.14198/GeoAlicante2015.42

Guerra-Santana M., Rodríguez-Pulido J., Artiles-Rodríguez J. (2019), Aprendizaje colaborativo: experiencia innovadora en el alumnado universitario. Revista de estudios y experiencias en educación (Collaborative Learning: An Innovative Experience for University Students. Journal of Studies and Experiences in Education), 18 (36). [Article in Spanish] DOI: https://doi.org/10.21703/rexe.20191836guerra5.

Heywood I., Cornelius S., Carver S. (2011), An introduction to geographical information systems. Pearson. London. ISBN 978-0131293175

Johnson David W., Johnson Roger T., Holubec Edythe J. (1994), Cooperative Learning in the Classroom. Virginia: Association for Supervision and Curriculum Development. (Trad. Vitale, Gloria, 1999). ISBN 978-0871202322

Junta Castilla y León (2024a), Consejería de Educación de la Junta de Castilla y León. Estadísticas (Castilla y León Regional Government Education Department). URL: https://estadistica.jcyl.es/web/es/estadistica.html. Accessed on 14.11.2024.

Junta Castilla y León (2024b), Sistema de Información Urbanística de Castilla y León (SITCYL) (The Castilla y León Information System). URL: https://idecyl.jcyl.es/siur/. Accessed on 14.11.2024.

Junta Castilla y León (2024c), Sistema de Información Urbanística de Castilla y León (SIUCyL viewer). URL: https://bocyl.jcyl.es/siucyl/.Accessed on 14.11.2024.

Junta Castilla y León (2024d), Dirección provincial de Soria-Portal de Educación-Educacyl (the Provincial Board of Education). URL: https://www.educa.jcyl.es/educacyl/cm/dpsoria. Accessed on 14.11.2024.

Kagan S., Kagan M. (2009), Kagan Cooperative Learning. Kagan Publishing. San Clemente, CA. ISBN 9781933445403

Kholoshyn I. V., Bondarenko O. V., Hanchuk O. V., Shmeltser E. O. (2019), Cloud ArcGIS Online as an innovative tool for developing geoinformation competence with future geography teachers. CTE Workshop Proceedings, 6, 403-412. DOI: https://doi.org/10.55056/cte.401

León de Aranoa L. (2002), Los lunes al sol - Trailer ESP https://www.youtube.com/watch?v=CG2XjTf7D5E

Martí-Parreño J., Galbis-Córdova A., Currás-Pérez R. (2021), Teachers' beliefs about gamification and competencies development: A concept mapping approach. Innovations in Education and Teaching International 58(1), 84-94. DOI: https://doi.org/10.1080/14703297.2019.1683464

Longley P. A., Goodchild M. F., Maguire D. J., Rhind D. W. (2015), Geographic Information Systems and Science. Wiley. New Jersey. ISBN: 978-0470870013

Mapping GIS (2024), Tendencias en SIG e IoT (Trends in GIS and IoT). URL: https://mappinggis.com/2023/03/10-tendencias-de-futuro-en-gis/. Accessed on 14.11.2024

Miguel González R. (2014), Aprendizaje por descubrimiento, enseñanza activa y geoinformación: hacia una didáctica de la geografía innovadora (Discovery Learning, Active Teaching, and Geoinformation: Towards an Innovative Geography Didactics). Didáctica Geográfica, 14, 17–36. [Article in Spanish]. ISSN 2174-645. URL: https://didacticageografica.age-geografia.es/index.php/didacticageografica/article/view/230

Miguel González R., de Lázaro M. L., Gil J. V., Sánchez I. B., Moreno C. G. (2016), Atlas digital escolar: aprender Geografía con ArcGIS Online (Digital School Atlas: Learning Geography with ArcGIS Online). In: Sebastiá Alcaraz R., Tonda Mollar, M.E. (eds) La investigación e innovación en la enseñanza de la Geografía (Research and Innovation in Geography Teaching). Alicante: Instituto de Ciencias de la Educación, Universidad de Alicante, 925–936. [Book in Spanish]. http://dx.doi.org/10.14198/GeoAlicante2015.68

Palazón A., Gómez-Gallego M., Gómez-Gallego J. C., Pérez M. C., Gómez J. (2011), Relationship Among Application of Active Teaching Methodologies and Learning of University Student. Bordón, 63 (2), 27-40. [Article in Spanish]. URL: https://recyt.fecyt.es/index.php/BORDON/article/view/28969

Prats J. (2017), Retos y dificultades para la enseñanza de la historia. En La historia en el aula: innovación docente y enseñanza de la historia en la educación secundaria, Editorial Milenio, Lleida, 15–32. [Article in Spanish]. ISBN 978-84-9743-763-9

Salas M. W. (2007), Evaluación del desempeño de los docentes: Teoría de investigación (Teacher Performance Evaluation: Research Theory). Universidad Veracruzana. México. [Book in Spanish]. ISBN 9789688347737

Santana-Tavera K. (2022), El uso de las TIC en la educación (The use of ICT in education. Vida Científica Boletín Científico De La Escuela Preparatoria No. 4, 10(19), 5–8. [Article in Spanish]. URL: https://repository.uaeh.edu.mx/revistas/index.php/prepa4/article/view/8388

Vasconcelos Santillán J. (2015), Tecnologías de la Información (Information Technologies). Grupo Editorial Patria. México. [Book in Spanish]. ISBN 9786074382065

Velilla-Gil C., Guallart-Moreno C., Laguna-Marín-Yaseli M. (2021), El desarrollo sostenible en las aulas de Educación Secundaria: cambio climático, migraciones y despoblación mediante la utilización de Web-SIG (Sustainable development in secondary education classrooms: climate change, migration and depopulation through the use of Web-GIS). In Granados-Sánchez, J., Medir-Huerta, M. (eds) Enseñar y aprender geografía para un mundo sostenible (Teaching and learning geography for a sustainable world), Octaedro, Barcelona, 69–82. [Book in Spanish]. ISBN 9788418615788.

Walshe N. (2016), Using ArcGIS online story maps. Teaching Geography, 41(3), 115-117. URL: https://www.proquest.com/docview/1952375297?sourcetype=Scholarly%20Journals