

Geographic Information Systems (GIS) as a semiotic and communicative medium for enhancing the role of algerian artisans in the national economy

نظم المعلومات الجغرافية كوسيط سيميائي وتواصل
لتعزيز دور الحرفيين الجزائريين في الاقتصاد الوطني

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Abstract:

Digital maps, from maritime navigation systems like ECDIS to Geographic Information Systems (GIS), have evolved into interactive interfaces linking perception, cognition, and culture. This study examines how such systems can foster inclusive spatial communication for Algerian artisans by integrating semiotic, cognitive, and cultural dimensions into digital cartographic design. How can GIS, inspired by maritime systems like ECDIS, become a cultural inclusive medium integrating artisans' spatial and symbolic knowledge?

Key words: Semiotic cartography, Geographic Information Systems (GIS), Visual Communication, Artisans, Land-based mediation.

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ملخص:

تطوّرت الخرائط الرقمية من أنظمة الملاحة البحرية مثل نظام ECDIS إلى أنظمة المعلومات الجغرافية (GIS)، حيث لم تعد الخريطة مجرد أداة تقنية، بل أصبحت واجهة تفاعلية تربط بين الإدراك والمعرفة والثقافة. تسعى الدراسة إلى بيان كيف يمكن لمثل هذه الأنظمة أن تعزّز التواصل المكاني الشامل للحرفيين الجزائريين، من خلال دمج الأبعاد السيميولوجية والإدراكية والثقافية في تصميم الخرائط الرقمية. وانطلاقاً من هذا المنظور، تطرح الدراسة السؤال الآتي: كيف يمكن لأنظمة المعلومات الجغرافية، المستلهمة من النظم البحرية مثل ECDIS، أن تصبح وسيلة تواصل ثقافي شاملة تُدمج فيها المعرفة المكانية والرمزية للحرفيين؟

الكلمات المفتاحية: الخرائط السيميائية، أنظمة المعلومات الجغرافية، التواصل البصري، الحرفيون، الوساطة الإقليمية.

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Introduction:

Maps have long been central to human societies, serving as orientation devices and symbolic mediations between lived territories. In the digital era, interactive systems such as Geographic Information Systems (GIS) and maritime platforms like ECDIS (Electronic Chart Display and Information System) transform the map from a static representation into a dynamic interface that invites interaction.

This change is an epistemological and semiotic shift: the map moves from information tool to medium of communication. The shift is crucial for contexts often neglected by cartography, notably traditional Algerian craftsmanship. Artisans hold rich sensory and narrative spatial knowledge but remain largely invisible in current GIS because systems employ graphic and cognitive codes foreign to their practices. Their everyday use of Google Maps reflects intuitive digital adaptation rather than formal cartographic literacy; inclusive GIS policies must build on these practices.

The central hypothesis states that the move from conventional maps to GIS redefines the map as a communicative object: the user becomes an interlocutor who co-creates spatial meaning. Therefore, GIS should be redesigned as living semiotic systems enabling fair visual dialogue across cultural registers.

This study rests on three pillars: (1) the transition from geographic information to geographic communication; (2) the contribution of visual semiotics to interpreting maps as cultural images; and (3) evidence drawn from interactive systems such as ECDIS.

How does the transition from conventional maps to GIS transform the map into an image of meaning and a tool of land-based communication for artisans, and what semiotic, cognitive, and graphic conditions are required to make such communication possible, legible, and shared?

1) Conceptual framework:

Understanding the transition from the conventional map to modern Geographic Information Systems (GIS) requires redefining the map as both a semiotic image and a cultural medium. This evolution exceeds technical progress: it represents a paradigm shift in spatial representation and perception. Far from being neutral, the image mobilizes a complex system of signs, visual conventions, and symbolic mediations that engage the user's sensory, cognitive.

1-1) The map as a meaningful image and cultural mediation:

Building on Bertin's semiology of graphics (1967¹) and Dondis's visual communication theory (1973²) and cultural competencies (1964³), this study argues that digital maps engage users in a sensory and symbolic dialogue: they depict but also call and guide. Yabus's work (1967⁴) shows that visual attention is shaped by context and culture, so perception guides how one reads and understands maps.

Based on graphic semiology, cultural interpretation, and cognitive dynamics, this framework views the map as a communicative interface rather than a static depiction. Following Bertin's visual grammar, cartographic representation operates through three interdependent levels: the note (elementary symbol), the series (variation enabling comparison), and the schema (systemic synthesis). These allow identification, comparison, and comprehension - the essential cognitive operations of map reading⁵.

When applied to GIS, this structure enables semiotic coherence across layers and user interactions:

- *Notes* correspond to individual symbols (e.g., craft icons),
- Series show variations (strength, duration),
- Schemas integrate these into land-based or socio-economic networks.

However, digital environments challenge this legibility. The GIS map, composed of dynamic layers and filters, disrupts the conventional “semiotic contract” between GIS designer and reader. Meaning becomes user-dependent and requires advanced digital literacy - often inaccessible to non-experts.

The image, therefore, must be considered a cultural interpretative system. It mediates not only spatial orientation but also symbolic and mnemonic connections. Recognizing a familiar space -like a workshop, market, or route-activates memory and identity more than metric understanding. Each effective GIS design must therefore embed shared cultural references to achieve semantic clarity across diverse communities.

From a sensory-cognitive perspective, vision follows structured, task-driven patterns⁶. However, in digital maps, the lack of clear anchors - due to excessive layers and weak visual hierarchy - reduces perceptual coherence. Designing GIS for public accessibility thus requires restoring visual anchoring points and ensuring perceptual legibility.

The GIS, accordingly, evolves from a database to an interactive communicative system. Spatial data are not merely coordinates but socially constructed information. Interaction transforms users from passive readers into co-interpreters of spatial meaning. This transformation parallels the maritime transition from traditional nautical charts to ECDIS (Electronic

Chart Display and Information System), where static reading gives way to dynamic negotiation. The ECDIS user configures, rather than reads, the map - illustrating a broader shift from the semiotics of representation to the semiotics of interaction. Similar principles can inform inclusive GIS design for artisans or local actors, making maps genuine interfaces of cultural mediation.

The success of the communication depends on the following three conditions:

- Sensory legibility - clear visual hierarchy;
- Cultural interpretability - shared semiotic codes;
- Cognitive interactivity - intuitive navigation and structured meaning.

When all these three conditions met, GIS becomes an interactive visual language enabling users to express, locate, and interpret their own spatial experiences.

This representation change reflects what Kitchin ⁷ describe as the transformation of mapping into an active practice - a strong communicative process rather than a poor passive representation.

1-2) Paradigm shift: From the informative map to the communicative map:

Map's evolution reveals a gradual transformation in how spatial information is represented and exchanged. The shift from conventional maps to GIS constitutes not a technological upgrade but a paradigmatic redefinition of the relationship between space, information, and human interaction⁸.

The traditional map, grounded in graphic semiology⁹, functioned as a stable, coded image governed by conventions of scale, direction, and legend. The reader decoded a predefined message - a unidirectional transmission of information¹⁰. In contrast, the digital map introduces a multilayered, dynamic, and interactional system in which users manipulate data, apply filters, and generate personalized representations. Meaning is thus co-constructed through interaction rather than delivered by the cartographer.

The ECDIS model illustrates this transformation. Traditional nautical charts relied on fixed, international standardized codes; ECDIS, by contrast, integrates vector data, radar overlays, AIS alerts, weather-related layers, and dynamic routing. Every manipulation (zoom, filter, parameter adjustment) modifies the displayed image. The screen becomes a space of action as much as of reading. Indeed, empirical experience with ECDIS interfaces, which shows that the map can become a device for interaction, safety and situational reading in real time - consistent with the operational standards defined by the International Maritime Organization¹¹ in its ECDIS – Guidance for Good Practice.

This interactive logic extends to GIS, where users navigate, configure, and negotiate spatial representations in real time. Consequently, the map has become a communicative device rather than a mere informative support¹². It facilitates dialogue between user, data, and territory. In this model, communication equals information $\times$ relation: it involves interpretation, projection, and exchange. GIS thereby transforms spatial experience into an interactive process of knowledge co-creation, enabling participants - such as Algerian artisans - to move from being mapped to mapping subjects.

This shift entails major semiotic and cognitive implications. Reading becomes non-linear and multi-scalar; users must acquire new skills - navigation, selection, filtering, and spatial projection¹³. When well designed, inclusive GIS interfaces can therefore serve as spaces of shared meaning, allowing users from different culture to articulate and visualize their spatial knowledge.

At its core, the communicative map transcends its informative function: it questions, reacts, and transforms. It is both a symbolic and social interface - an active practice of mediation between technology, culture, and lived territory.

2) The Case of algerian artisans: Between semiotic invisibility and expressive potentials:

Unlike contexts where mapping has long been embedded in daily life, Algerian artisans have rarely used maps as relational or professional tools. Spatial orientation traditionally relies on oral exchange, gesture, and sensory memory rather than graphic abstraction. The arrival of digital mapping platforms such as Google Maps introduced an initial form of spatial digitalization - an interactive, real-time tool for locating and guiding. However, its functionality remains limited to navigation and excludes the cultural or professional realities of local craftsmanship. This lack of meaningful representation underlines the challenge GIS must now address.

2-1) Algerian artisans and reality:

The exclusion of Algerian artisans from GIS environments arises from a combination of technological, cultural, and graphic barriers. Limited access to devices and the internet connectivity - especially in non-urban areas - prevents effective use. Even when available, GIS systems designed for institutional or expert audiences remain difficult for users without adequate training. As far as cultural context is concerned, artisans inhabit semiotic worlds rooted in oral, gestural, and material traditions, while GIS operates through abstract and standardised graphic codes. This disjunction produces semiotic dissonance: the map is not misunderstood because of illiteracy, but because it speaks another language¹⁴. Graphically, the layered and dynamic logic of GIS can be disorienting; the lack of sensory anchors and visual hierarchy impedes orientation¹⁵, mirroring the confusion faced by non-experts with ECDIS in maritime navigation.

Craft practices themselves are sensory and narrative: space is not only located but lived and told. Workshops, souks, and craft circuits carry layers of memory and symbolism. However, GIS tends to reduce these lived spaces into neutral entities - points, lines, or polygons - thus stripping them of symbolic depth. This generates what can be termed "semiotic invisibility": artisans are not absent from digital maps, but they remain unseen within the map's own language. The symbolic codes of map designing¹⁶ here become a mechanism of exclusion through inadequate mediation.

Despite these gaps, artisans display strong potential for digital engagement when tools are adapted to their culture. Local initiatives show that artisans successfully use mapping interfaces to locate workshops, add photos, report events, or comment on routes - once interfaces allow intuitive participation. This demonstrates that exclusion is not due to incapacity but to design. When given tools that make sense across cultures, artisans become active producers of spatial meaning rather than passive data points. They emerge as communicative subjects: interlocutors of the map capable of co-creating representations that reflect their own cognitive and cultural systems.

For this to occur, craft-based forms of expression must be recognised as legitimate spatial units of meaning. Interfaces need to support annotation, signalling, and contextualisation, transforming the map from a database into a medium of symbolic communication. The invisibility of Algerian artisans thus stems not from informational deficiency but from the lack of semiotic inclusion. Enabling artisans to act as cartographic subjects requires rethinking the map as an open, co-produced, and shareable interface of meaning.

2-2) Proposals for semiotic reconfiguration:

To bridge these fractures, a semiotic mediation model should integrate technical, cultural, and symbolic dimensions. Such a model would rely on four main axes:

1. Iconographic adaptation – drawing graphic signs and pictograms from local artisan culture (materials, motifs, colours).
2. Linguistic adjustment – aligning categories, legends, and layers with local terminologies.
3. Multi-sensory enrichment – integrating sound, image, and narrative inputs to complement visual data.
4. Collaborative design – allowing users to comment, co-design, and share data interactively.

This aligns with human-centred GIS research¹⁷ and AI-assisted semiotic translation¹⁸, aiming not only for technical accessibility but for semiotic empowerment.

Designing clear and culture aware interfaces requires both sensory simplification and symbolic anchoring. Based on visual semiology¹⁹, GIS interfaces should reduce unnecessary layers, use figurative pictograms derived from craft universes, and provide intuitive legends allowing quick reading followed by deeper interpretation. Meaningful colours, motifs, and local names reflecting local culture, should replace generic symbols to enhance recognition and engagement.

Principles of multimedia learning²⁰ can optimise cognitive readability: coherence (eliminate decorative noise), signalling (highlight key information), spatial contiguity (place labels close to their referents), segmentation (organise data by thematic layers), and multimodality (combine

text, icons, and sound). Applying these principles transforms GIS from a complex technical device into a legible, embodied space of communication. Empowering artisans also requires interfaces that enable expression rather than passive use. Simplified data entry, photo or voice annotations, and local validation mechanisms allow artisans to map their activities and narratives. These features make the map a collective memory device and a means of recognition for territories often excluded from formal representation. Five paradoxes summarise the semiotic tensions observed in field practices: (1) desire for utility despite unfamiliarity, (2) visibility versus surveillance, (3) knowledge without representation, (4) immobility within dynamic systems, and (5) disappearance through omission. Addressing these paradoxes demands adaptive interfaces translating lived experience into cartographic imagery.

Integrating artificial intelligence can enhance this adaptive potential. Unlike data-driven AI, semiotic AI interprets usage patterns, recognises cultural signals, and adapts interfaces dynamically. It acts as a mediator, simplifying visuals, detecting underrepresented zones, and promoting co-construction. Existing tools such as GeoAI²¹ and QField²² already demonstrate such possibilities, confirming the technical feasibility of semiotic cartographic intelligence²³.

However, interactivity must extend beyond ergonomics to what can be called cultural ergonomics - interfaces that ensure symbolic comfort and intuitive semiotic resonance²⁴. Interface elements should evoke the tactile and rhythmic world of crafts, with evolving icons and colour codes co-designed through collaborative workshops. This ensures not only usability but identification: users recognise themselves in the map's language.

In the end, interactive cartography is both a semiotic framework and a political act. By restoring communication between map and maker, it reclaims representational agency for communities historically excluded from cartographic discourse. Three conditions define this inclusive paradigm: (1)

descriptive inclusion - allowing local actors to encode their own symbols and narratives; (2) collaborative governance - engaging local institutions as mediators; and (3) reflexive circulation - ensuring maps return to and evolve with the communities that produced them. Such maps become living archives and shared cultural spaces, where visibility, identity, and agency converge. The map thus becomes not a command but a conversation - a common language of spatial meaning and cultural continuity.

Conclusion:

This research has demonstrated that the digital map, from maritime systems such as ECDIS to terrestrial GIS, has evolved from an instrument of information into a semiotic interface of communication. Through visual semiology, communication theory and perceptual studies, it shows that mapping now engages a cognitive, cultural, and sensory dialogue with its users. The Algerian artisans' case confirms the necessity of cultural and semiotic adaptation in digital cartography.

Research results:

- The digital and interactive map functions as a semiotic interface connecting perception, cognition, and cultural interpretation;
- Artisans' invisibility in GIS stems from the lack of sensory, cultural, and interactional adjustment rather than from technical incapacity;
- The GIS user becomes an interlocutor contributing to spatial meaning production;
- The communicative efficiency of the map depends on sensory readability, cultural interpretability, and cognitive interactivity;

Research recommendations:

- Develop narrative and collaborative GIS prototypes grounded in local and craft-based spatial cultures;
- Introduce training in visual semiology and communication design for developers and users;
- Create contextual graphic standards and visual codes adapted to local culture;
- Promote semiotically intelligent GIS integrating GeoAI for inclusive mapping.

Finally, GIS must evolve toward systems that not only process data but communicate meaning - enabling all users, including artisans, to represent, share, and co-create their spatial worlds.

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