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VISUAL CULTURE AS A STRATEGY FOR TEACHING CONTEMPORARY GEOMETRY: Reflections and Proposals

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ABSTRACT

This article proposes a pedagogical reflection on the importance of raising teachers' awareness to recognize the value of the urban environment, especially the architecture of Guayaquil, as a visual resource for teaching geometry. From a qualitative and descriptive approach, a theoretical review is conducted, and using visual culture as a connecting axis, three buildings with geometric richness and heritage value are presented, along with a didactic sequence. Additionally, an educational itinerary with technological extension is proposed that projects the proposal into the 21st century. It invites us to re-signify the city as an expanded classroom and visual text.

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1. Introduction

Mathematics is a fundamental subject in the education of every human being. Although most people always identify it within the realm of learning, and of course, internally within the academic perspective. It has special value in the curriculum because it is an essential area for intellectual development, especially logic and critical thinking (Organization of Ibero-American States [OEI], 2015). Even though it is popularly considered one of the most difficult subjects, it has a significant impact on economic, cultural, and social life.

It is a vital subject for the development of skills such as problem solving and decision making. It accompanies the development of other dissimilar sciences, and its importance for technological innovation cannot be overlooked.

Despite all this recognition, it is a subject that arouses passion and disaffection in students due to the difficulties it presents (Zuazua and Rodríguez, 2002), and some consider it a monotonous discipline that cuses frustration and failure (Prado et al., 2013).

Within the broad field of mathematics is the learning of geometry, a subject in which some teachers tend to describe their students as "blind" to appreciating the secrets of learning during their teaching.

This expresses a general approach to a real problem, but specifically, it must be taken into account that, in order to learn mathematics and geometry, one must not only have the concept of teaching the content established by the institutional program, but also life itself.

According to Fernández et al., (2003 p.1), this implies "knowing how to sufficiently relate abstract concepts and content to concrete, everyday reality, because cognitive psychology tells us that appropriating any aspect of reality involves representing it, that is, to construct a mental model of that reality" obtained from a mental image, which, according to Padúa and Casanueva (2021), is part of cognition in general, belonging to the imaginative capacity and synthesizing, to a large extent, a mental environment.

School mathematics, through its programs, curricula, and educational models, generates a dominant discourse. Seen in this light, it is possible to conclude that it does not consider or recognize the use of people's mathematical knowledge (Cordero, 2015).

The underlying problem is that, in most cases, everyday life is completely excluded from what happens in the classroom, and it is under these conditions that students must learn mathematics (Cordero et al., 2019), when the main purpose of teaching and learning mathematics, and especially geometry, is to connect students with the world in which they live, since knowledge, intuition, and geometric relationships are very useful in the development of everyday life (Barrantes, 2003).

The formalist trends of past decades have led many teachers to prioritize the formal presentation of mathematics and to neglect the visual intuition of mathematical concepts and thought processes (Nelsen, 2015).

It is interesting to note that, since the emergence of the word itself, the term geometry has been linked to real-world problems. Etymologically, the word "geometry" means "measurement of the earth," alluding to a practical origin.

In ancient times, problems related to the demarcation of land were solved by establishing boundaries for building houses, etc. Euclid was the one who converted or transformed the use of geometry into a reflective model of physical and geometric space, in which reasoning, deduction, and representation are vital. Its remote origin is related to the periodic flooding of the Nile River over farmland. (Veschi, 2019)

Following this approach, the idea of a mental analysis of how geometry is currently taught will have been planted, because from an educational perspective, and conceived within the vast universe of mathematics, geometry occupies a central place in the development of logical and visual thinking. When addressing it in the classroom, not only are abstract concepts taught, but understanding of the environment is strengthened, fostering key cognitive skills for the comprehensive education of students.

Therefore, the objective is to sensitize teachers to the possibilities offered by their urban environment, particularly the architecture of Guayaquil, as a visual resource to enrich the teaching of geometry and stimulate spatial thinking in students.

The idea of presenting the content of the article from the verbal perspective of raising awareness, as its meaning indicates, is that it is not only an informative document but, without imposing, seeks to touch hearts, generate awareness, and open paths to new ways of looking and acting that benefit teaching, even reaching the technological-digital perspective for teaching geometry.

With these arguments in mind, the following epigraph begins with the development of a theoretical foundation based on the exploration of the concepts that make up the variables of the topic of communication for the benefit of teaching geometry in basic education. The selected context corresponds to the city of Guayaquil and details of its architecture as a resource for promoting geometric thinking skills. Finally, possible proposals for walking, looking, seeing, and learning geometry in the city.

2. Theoretical foundations

This section brings together theoretical arguments to reflect on the perspective of appreciating visual culture as a teaching strategy. It highlights the use of the prepositions *"by"* and *"for"* as a fundamental play on words in order to understand that it is not a question *of teaching* visual culture but *rather of using* visual culture as a means of strategic integration. In this case, the concepts of visuality and visualization enthrone the understanding that looking is not the same as seeing.

2.1. Teaching geometry "through" visual culture: strategic integration

Barrantes et al. (2013) emphasize that geometry promotes and develops a series of skills in students, such as visual perception, verbal expression, logical reasoning, and application to specific problems in other areas of mathematics or other subjects.

From this perspective, this statement is very interesting because it offers the possibility of linking students' thinking and cognitive development to visual culture as a strategic integration in the teaching of geometry. This alternative can offer a powerful way to improve learning experiences, particularly in the context of architecture.

The perspective of strategic integration of visual culture in the teaching of geometry is based on the idea of Salbego and Charreú (2019), who state as their central argument that visual culture can be understood as a type of method or strategy for interconnecting the contents of school with the everyday lives of students outside school, given that they do not share the alternative of teaching visual culture, but rather teaching through visual culture, as a bridge between school content and students' lives outside of school. Above all, they consider students' participation in the learning process by guiding them in the realization of visual practices.

With regard to this form of teaching, Bestard and López (2018) addressed the issue from the perspective of the diverse educational potential of artistic works located in public spaces in the city to promote the teaching of history. In this experience, the aforementioned authors propose the algorithm of actions: observe, interpret, understand, describe, as evidence of this marked relationship mediated by the necessary process of pedagogical heritage interpretation that the teacher, during the creative process of their class, can give to that work created in the city.

By taking advantage of visual practices, educators can create engaging and meaningful lessons that connect geometric concepts with real-world applications. With this starting point, Flores (2010) emphasizes the integration of visual culture into mathematics education, including geometry, through the exploration of visual practices and historical contexts.

2.1.2. "Through" visual culture: the visuality and visualization of everyday life beneficial to the teaching of geometry

Visuality, as an object that conveys historicity and also as a strategic platform of high cognitive interest (Meneses, 2003), enters into the debate about the importance of visual culture, due to the specificity of the idea of visuality for the constitution of various ways of seeing, including the mathematical gaze, mathematical visualization. In this case, mathematical visualization is understood as a form and/or expression of thought, a form of experience, a way of looking and thinking.

On the subject of visualization, Presmeg (2006) provides an evolutionary overview of the presence of visualization in mathematics education, highlighting that:

> In the late 1970s and early 1980s, qualitative and quantitative studies on human visual perception and mathematical thinking were identified. In the 1990s, visualization was recognized in mathematics education, and some studies began to discuss aspects of curriculum development and the effectiveness of visualization for mathematical learning. A strong trend emerged, linked to the incorporation of affective and cognitive aspects as essential components for visualization in mathematical problem-solving processes. Starting in 2000, there was a broadening of the research focus, which began to consider semiotic and theoretical aspects of visualization. There is also an increased interest in the theoretical understanding of the concept of image and representation, placing mathematical image and representation in that context. Presmeg (2006).

Later, this process is evidenced by the published results of several researchers cited by Hernández, Garcés, and Grimaldy (2021):

- Visualization plays a leading role in the teaching and learning process of mathematics today. Its use gives meaning to problem situations, in which different levels of visualization can be deployed (Figueiras and Deulofeu, 2005).
- Highlights the usefulness of visualization in the process of posing and solving mathematical problems (Peña, Assaleh 2025), (Duval, 2011).
- Better results are obtained when technological resources are used in their treatment, by identifying numerical patterns; between figures of movement and relationship behaviors (Ruiz and Elena, 2013).

Geometry is present in production, art, technology, and nature, and plays an important role in the transformation of the surrounding objective reality.

Teaching and learning geometry in the school context helps students form a scientific conception of the world. It facilitates the acquisition of a comprehensive culture and scientific thinking that prepares them for social and working life, so that they maintain a responsible and committed attitude towards the problems of society, science, and technology. But how should teachers proceed so that students can apply these benefits to their everyday lives?

2.1.3. Visualization: looking at and seeing the city to learn geometry from everyday life

In their daily comings and goings, students, for example, travel every day to their school or other places. These may be the city, the town, the neighborhood, or the area surrounding their own home. Perhaps they walk through these places with certain thoughts in their minds, chatting with friends, paying attention to a particular interest, or even their own concerns, without visually perceiving the shapes and colors of the space they are walking through.

A house, a neighborhood, a building, public spaces, streets and sidewalks, monuments are reservoirs of time and memory that require a multiplicity of readings to become settings for integrative learning. (Espinosa-Castañeda. et al. 2022), (Ríos and Serra, 2015)

Beyond its functionality, the city has symbolic layers that can be explored in teaching, but teachers need to have a visual culture that allows them to encourage and guide students toward

the possibility of deciphering and transmitting deep meanings during the students' journey through their living space.

> In the second half of the 19th century and the first half of the 20th century, the wealthy bourgeoisie displayed their splendor in the architecture and decoration of their homes: with floral, mythological, and geometric motifs, (...) their facades, balconies, cornices, patios, and staircases (...) display symmetries, spirals, similarities, helices, borders, stars, circular figures, mosaics, polygons, etc. (Sorando, 2009)

In the content of this commentary (without specifically stating its geographical setting, given the possibility of similarities in many parts of the world), all these architectural details represent different geometric figures that teachers can use in their math classes, providing students with problems to solve using geometry. The first thing is to draw attention, look, see, identify, then describe, apply mathematical knowledge and especially geometry.

In its dictionary, the Royal Spanish Academy (RAE) clarifies the difference between the verbs "ver" (to see) and "mirar" (to look). According to the RAE, "mirar" implies directing one's gaze at something, while "ver" is perceiving something with one's eyes. The two verbs do not have the same meaning. Looking is a physical action we do with our body, while seeing is something that happens in our mind.

3. Methodology

This work is based on a reflective and proactive approach, in which the teacher's gaze becomes the connecting thread between geometry, visual culture, and the urban environment. This is not a traditional empirical investigation, but rather a pedagogical exploration that intertwines theory, image, and educational experience to open up new possibilities in the teaching of mathematics.

The process began with a review of specialized literature on mathematics education, geometric thinking, and visual culture, selecting texts that would allow for a critical and situated dialogue with the proposal. This review was not limited to systematizing concepts, but sought to recognize voices that inspire more sensitive, contextualized, and visually literate teaching.

Subsequently, architectural images of the city of Guayaquil were curated, chosen for their heritage value, geometric richness, and evocative power. These images—the House of Dr. Leopoldo Izquieta Pérez, the Crystal Palace, and the La Previsora Building—were treated as visual texts that allow us to read the city from the perspective of geometry and to think about geometry from the perspective of the city.

Based on these images, a didactic sequence was designed that proposes a real urban itinerary, complemented by a technological projection that invites the construction of interactive tours using digital tools. This proposal does not seek to offer a methodological recipe, but rather an open invitation to reinterpret the environment as a pedagogical space, where geometry is revealed in facades, shapes, and everyday routes.

3.1. Organizational aspects of the teaching proposal

In accordance with the criteria set out by Hernández (2017) and Blázquez (1994), as outlined in the article by Escobar et al. (2025) in Visual Review, this teaching proposal considers the following structural elements that guide its design and application:

- Learning scenarios: The city of Guayaquil is conceived as an expanded classroom, where heritage and modern buildings become living resources for working on geometric content in a meaningful way.
- Procedures: The methodological development includes guided observation of images, analysis of geometric shapes present on facades, creation of a visual log, and construction of a face-to-face or virtual urban itinerary.
- Teaching methods and resources: Architectural visual resources, digital tools such as interactive maps and collaborative platforms are used, as well as teaching strategies for aesthetic exploration, mathematical contextualization, and teacher awareness.

Participants: The proposal is aimed at secondary school students and teachers involved in mathematics education, especially in Latin American urban contexts with rich architecture.

Use of visual codes inherent to the medium: Architectural images are interpreted as visual texts which, through their shapes, symmetries, and structures, enable a mathematical reading of the environment and promote visual literacy.

Methodological contexts based on objectives: Priority is given to a flexible methodology, situated and adapted to visual analysis as a means of developing geometric thinking, in line with the educational objectives of the article.

Specification of the target audience: The itinerary is designed for students and teachers who live or work in cities such as Guayaquil, but with the possibility of adaptation to other urban environments that share geometric-cultural features.

Teacher mediation: The role of the teacher is recognized as that of a cultural mediator who facilitates the connection between formal knowledge of geometry and the aesthetic experience of the environment, promoting sensitive and contextualized learning.

4. Results

Teaching geometry can transcend the boundaries of the classroom when teachers develop a sensitive and critical visual perspective on their surroundings. In this sense, urban space becomes a living educational resource, where facades, structures, and architectural forms interact with mathematical concepts.

By incorporating images of the environment—such as the emblematic buildings of Guayaquil—spatial perception, visual discrimination, and understanding of geometric shapes in real contexts are enhanced.

4.1. Looking and seeing: the benefits of the city of Guayaquil for learning geometry from its architecture

Guayaquil, a well-known Ecuadorian city, has examples in its public spaces of the ancient and modern buildings referred to by Sorando (2009). This is the case, for example, with the Art Nouveau-style façade of the house of Dr. Leopoldo Izquieta Pérez.

It is not relevant to this communication to refer to the architectural style or its forms (although the subject is equally interesting and cultural from an artistic perspective, but that would be practically another communication). What is interesting, above all, is to observe, look, see, and identify how many geometric shapes can be seen on that facade.

This façade is an architectural element of the Art Nouveau style that allows us to identify geometric figures such as arches, ovals, spirals, and radial symmetries. This image can be used by teachers as a visual trigger to work on figure-ground perception, visual memory, and the relationship between art and geometry.

Figure 1. Facade of the house of Dr. Leopoldo Izquieta Pérez.

Source: (Photo courtesy of Guayaquil: Traditions and customs of my land, Facebook)

Reference link:
https://www.facebook.com/Guayaquil2020/photos/a.398990884287895/

A modular structure is shown that incorporates repetitive shapes such as rectangles, triangles, and trapezoids in its design. It represents a useful visual resource for promoting visual differentiation, perceptual constancy, and the analysis of spatial patterns in the classroom.

Figure 2. Crystal Palace (1907) facing the Guayas River in Guayaquil, Ecuador.

Source: Reference link: https://es.pinterest.com/pin/254312710200871828/

This building represents contemporary Guayaquil, showcasing modern architecture from the 1990s, with straight lines, prismatic volume, and great height. From an educational perspective, it is excellent for working on three-dimensional shapes, proportions, verticality, and scale.

This modern building introduces vertical, prismatic, and contemporary geometry that also inhabits everyday space. It is a powerful way to perceive that geometry is in everything, in the past, in the present, and in what we dream of building.

Figure 3. La Previsora Building. Avenida 9 de Octubre and Avenida Malecón Simón Bolívar.

Source: https://es.pinterest.com/pin/435090014017134063/

The set of images presented in this part of the communication has sought to raise awareness among teachers about the educational potential of urban architecture as a teaching resource for the development of geometric thinking. Observing heritage facades such as these opens up other ways of integrating mathematics with history, aesthetics, and the cultural identity of the environment.

4.2. The proposal: teaching sequence – real teaching itinerary and virtual geometric itinerary

Below is a proposal organized in the form of a teaching sequence, accompanied by an idea for a real teaching itinerary, which invites teachers to recognize themselves as cultural mediators, capable of transforming the city into a visual laboratory for the development of geometric thinking. However, in keeping with the technological contemporaneity that characterizes the 21st century, the paper concludes by offering a virtual geometric itinerary.

4.2.1. Proposed teaching sequence: "Geometric route through Guayaquil"

- Title: Discovering geometry in the city: a visual route through Guayaquil
- Suggested level: Upper elementary or teacher training
- Objective of the sequence: To encourage the development of geometric thinking through observation, analysis, and representation of geometric shapes present in emblematic buildings in Guayaquil.

Suggested stages:

- Activation of prior knowledge
- Discussion: Where do we see geometry in our city?
- Display of images of buildings (Art Nouveau House, Crystal Palace, La Previsora Building).
- Guided visual exploration
- Analysis of images in the classroom: identification of figures, symmetries, patterns.
- Introduction to related geometric concepts (polygons, shapes, axial symmetry, etc.).

4.2.2. Proposal for a (real) urban educational itinerary

To refer to the concept of educational itineraries, we turn to Lara and Lopes (2023), who characterize them as pedagogical tools that have long been present in school curricula. They are part of a school tradition present in school systems in different countries. They are pedagogically innovative because of the different forms they can take and have immense motivational power, with a proven ability to promote valuable learning for students.

They are understood as activities carried out outside the school environment to bring students into direct contact with a certain reality, rural or urban, that they wish to study. They aim to provide students with the acquisition of values, skills, and curricular knowledge that they would find difficult to access through traditional classroom activities. During these activities, students take an active, participatory, and meaningful stance as they begin to understand certain content beyond their everyday experiences.

The educational urban tour itinerary can become an exceptional resource for teachers working at various levels of education, helping them to use the city to achieve specific learning objectives and, above all, to foster a sense of belonging among students in relation to their living space.

The itinerary proposal presented below covers the built urban spaces belonging to the city of Guayaquil, which have previously been presented in the form of images.

- Visit to three key points:
  - House of Dr. Izquieta Pérez (Art Nouveau ornamentation and curves)
  - Crystal Palace (modularity and repetition)
  - La Previsora (prismatic shapes and proportion)
- Photographic record or field sketches.
- Creative production
- Creation of a "Geometric Map of Guayaquil" with the identified shapes.
- Writing a visual log with reflections on what was observed.
- Closing and reflection
  - How does this tour change the way we see the city?
  - What other disciplines could be integrated into this experience?

4.3. The proposal for the use of technology and visual culture: towards contemporary geometric teaching

In a world deeply influenced by the visual and the digital, the incorporation of technologies such as mobile devices, augmented reality, virtual tours, and dynamic geometry applications allows us to expand the possibilities for exploring the urban environment.

This space for communication serves as an exhortation to teachers to use tools such as Google Earth, GeoGebra, or interactive mapping platforms to accompany their students in the creation of digital geometric itineraries, virtual galleries of architectural facades, or even visual reinterpretations of buildings by tracing their shapes.

Thus, the teaching of geometry, supported by visual and technological culture, not only develops cognitive skills but also competencies for inhabiting the world in a critical, creative, and connected way.

4.3.1. Proposed technological extension: Interactive Map of Urban Geometry

Suggested name: "Geometry in my city: a visual route through Guayaquil"

- What is it? A proposal for an interactive digital resource where teachers and students can:
  - View key architectural points on a geolocated map.
  - Upload or access photos of facades with geometric comments.
  - Draw on images (identifying shapes, symmetries, etc.).
  - Share short reflections or visual logs of the tour.
  - Possible tools for developing this:
  - Google My Maps: to mark locations with descriptions and images
  - Padlet or Genially: to create an interactive gallery with annotations
  - GeoGebra: to reproduce geometric figures observed in situ

Finally, incorporating technology as an ally of visual culture opens up new pedagogical paths where the urban, the geometric, and the digital intertwine. A "geometric itinerary of Guayaquil" can become a collaborative interactive map, a visual repository with comments, or even a gamified experience that connects students with their city from a mathematical perspective. Thus, the teaching of geometry embraces the 21st century with a critical, sensitive, and connected outlook.

5. Discussion

The proposal presented demonstrates that geometry teaching can be substantially enriched when linked to the visual environment of the student and teacher. Raising awareness of urban architecture—as illustrated by the analysis of three representative buildings in Guayaquil—allows not only for the development of geometric thinking skills, but also for the integration of cultural, aesthetic, and emotional dimensions into the educational process. This integrative approach does not seek to replace traditional approaches, but rather to complement them with more meaningful strategies that are contextualized and linked to everyday experience.

Likewise, the inclusion of a technological extension in the form of an interactive itinerary allows this proposal to be projected onto 21st-century digital scenarios, opening paths to more inclusive and motivating practices.

This type of experience promotes critical visual literacy and a more active teaching role as a cultural mediator. However, the effective implementation of these strategies requires ongoing teacher training, access to adequate digital resources, and an institutional willingness to transform traditional teaching frameworks. Therefore, this work is positioned not as a closed solution, but as a starting point for new research and practices that recognize the city as a possible and living classroom.

6. Conclusions

The teaching of geometry, traditionally approached from an abstract and decontextualized perspective, finds in visual culture as a strategy for visualizing the urban environment an opportunity for pedagogical renewal.

The purpose of the article was to raise awareness among teachers about the educational potential of the city, particularly Guayaquil, as a living setting where geometric shapes take on meaning, history, and emotion as part of students' everyday reality.

Through the analysis of emblematic buildings—such as the House of Dr. Leopoldo Izquieta Pérez, the Crystal Palace, and the La Previsora building—it has been shown how it is possible to develop geometric thinking skills in students through guided observation that integrates aesthetics, space, and culture. These buildings not only represent diverse architectural styles, but also allow teachers to develop a critical and creative view of their everyday environment.

The proposed educational itinerary, in real or digital format, shows that geometry does not reside solely in books or on blackboards, but inhabits the streets, facades, and silhouettes of our cities. Incorporating technologies such as interactive maps, virtual tours, or collaborative visual platforms opens up the possibility of connecting the local with the global, the tangible with the symbolic, the traditional with the contemporary.

Finally, this proposal does not seek to provide a closed recipe, but rather an open invitation to rethink the teaching of geometry from a more sensitive, situated, and visually literate perspective. Because when teachers change the way they look at things, they also change the way they teach... and, as a result, they transform the way their students learn to see the world.

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