

Springer Series in Design and Innovation 43

Luis Hermida González

João Pedro Xavier

Antonio Amado Lorenzo

Ángel J. Fernández-Álvarez *Editors*

# Graphic Horizons

Volume 2 - Graphics for Education and  
Production

 Springer

# Contents

## Graphics for Education

Development of Physical Simulations Using Artificial Intelligence for Implementation in BIM Methodology .....	3
<i>Federico Luis del Blanco García and Alejandro Jesús González Cruz</i>	
“Zero” Industrial Architecture in the Cultural Landscape of the Vega De Granada. A Teaching Experience .....	12
<i>Juan Francisco García Nofuentes, Roser Martínez Ramos e Iruela, and Jorge Gabriel Molinero Sánchez</i>	
Vilanova’s Porto. Didactic Experiments on Drawing .....	21
<i>Alexandra Castro, João Luís Marques, José Maria Lopes, José Pedro Sousa, and Pedro Varela</i>	
A Short Grand Tour .....	29
<i>Ana Torres Barchino, Juan Serra lluch, and Jorge Llopis Verdú</i>	
The Teaching of Surfaces, Between Geometry and Stereotomy .....	38
<i>Andrea Giordano, Rachele Angela Bernardello, Cosimo Monteleone, and Paolo Borin</i>	
Experimenting Graphically with the Relationship Between Form and Function Through Parametric Digital Models .....	47
<i>Fernando Díaz-Moreno and Eduardo Acosta Almeda</i>	
The Architectural Design Drawing Taxonomy Table: A Tool for Selecting and Elaborating the Appropriate Graphic Support for the Configuration of Themes in Architectural Design .....	55
<i>Federico Martínez Reyes</i>	
Graphic Thinking, Communication and Motivation: A Teaching Experience with Augmented Reality .....	61
<i>Ángel Martínez Díaz, Jara Muñoz-Hernández, and Gonzalo Sotelo-Calvillo</i>	
From Local Students to Local Scholars: From Naples the Experience of a Study Group that Used the Street as a Classroom .....	69
<i>Anna Teresa Alfieri</i>	

Playlist of Drawings .....	77
<i>María Villanueva Fernández, Francisco Xabier Goñi Castañón, and Armando Diago Bernáldez</i>	
Concept Takes Command: A Proposal to Teach and Learn Architectural Graphics with Digital Tools .....	85
<i>Ángel J. Fernández-Álvarez and Vicente López-Chao</i>	
Digital Photogrammetry as an Improving Means in the Early Stages of Architectural Drawing Learning .....	96
<i>Luis de Sobrón Martínez, Ángel Martínez Díaz, and Lycinia Aliberti</i>	
Searching for Measurement: A Logic of Limit into Architectural Graphic Learning .....	104
<i>María Teresa García Sánchez and Ángel Martínez Díaz</i>	
The Future of Learning Drawing: Exploring the Metaverse in Education .....	112
<i>Caterina Morganti and Cristiana Bartolomei</i>	
The Model as an Introduction to Graphic Learning: A Teaching Experience ....	122
<i>Jorge Gabriel Molinero Sánchez and Tomás García Píriz</i>	
The Creative Methodology Applied Through Graphic Thinking. Illustrative Case of the Design Workshop Subject .....	131
<i>Mónica del Río Muñoz and Isaac Mendoza Rodríguez</i>	
A Visual Framework, or How to Arrange Graphic Targets that Answer Architectural Concerns .....	140
<i>José Carrasco Hortal</i>	
The Work of Pablo Palazuelo as Inspiration for Utopian Cities .....	148
<i>Gonzalo Sotelo-Calvillo and Teresa Raventós-Viñas</i>	
Lego Lab .....	156
<i>Ricardo Santonja, Angel Cobo, and Javier Fco. Raposo</i>	
Conic Curves in Portraiture: Geometric Abstraction of the Elderly's Faces .....	164
<i>María del Pilar Salazar Lozano, Fernando Manuel Alonso Pedrero, and Juan Luis Roquette Rodríguez-Villamil</i>	
<b>Landscape and Heritage, Cave Dwellings, and Tourism in the Geopark of Granada as a Teaching Strategy for the Learning of Architecture .....</b>	<b>172</b>
<b><i>Miguel Martínez-Monedero and Jaime Vergara-Muñoz</i></b>	

Movable Models as Geometry Material .....	180
<i>Ana González-Uriel, Manuel Ramos-Martín, Licinia Aliberti, and María Guillem González-Blanch</i>	
Following the Footsteps of a Trip Through Spain Almost 100 Years Later .....	188
<i>Sandra Moliner Nuño, Isidre Santacreu Tudó, and Jordi de Gispert Hernández</i>	
Double Space-Time Loop in Drawing Learning: From Atelier to Urban Fieldwork Practices .....	198
<i>Eduardo Roig, Atxu Amann, Ángela Ruiz, and Bruno Seve</i>	
Drawing Crystalline Geometries: From Form to Illusion .....	206
<i>Virginia De Jorge Huertas</i>	
CHAOTIC ATELIER 2023 Edition – JOÃO PESSOA/Paraíba/Brasil: Drawings and Collages as a Creative Way of Expressing Ideas .....	213
<i>José Clewton do Nascimento and Eunádia Silva Cavalcante</i>	
Autonomy, Mastery, and Purpose in Descriptive Geometry Students: The Value and Importance of Long-Term Exercise .....	221
<i>Antonio Álvaro-Tordesillas, Víctor-Antonio Lafuente-Sánchez, Daniel López-Bragado, and Marta Martínez-Vera</i>	
From Drawing in the Landscape to Drawing from Memory .....	230
<i>Clara Maestre-Galindo</i>	
Women in Architecture: A Gaze from Descriptive Geometry .....	238
<i>María del Carmen Vilchez Lara</i>	
The Persistence of Tradition? Examining the Role of Freehand Sketching in Contemporary Design Education .....	248
<i>Mauro Herrero</i>	
Strategies for the Graphic Representation of Landscape .....	257
<i>Rocío Santo-Tomás Muro, Fátima Sarasola Rubio, and Guadalupe Cantarero-García</i>	
The Importance of Hand Drawing (Analog) in the Face of New Digital Technologies .....	265
<i>Luciana Massami Inoue</i>	

Playful-Experimental Teaching of Geometry. Architecture Students  
Designing Spaces for Children ..... 269  
*Juan Luis Roquette Rodríguez-Villamil,  
María del Pilar Salazar Lozano, and Fernando Manuel Alonso Pedrero*

**Graphics for Production**

From Copying to Emulating the Creative Process ..... 281  
*Ángel Allepuz-Pedreño, Carlos L. Marcos, and Sergio García-Doménech*

Virtual Reality to Evaluate the Size of Interiors with Different Colors ..... 289  
*Juan Serra, Mekides Assefa Abebe, and Michael J. Murdoch*

The Possibilities of Text-to-Image Tools for the Generation of Floor Plans ..... 297  
*Angélica Fernández-Morales*

Tactile Translations: Algorithmic Modelling for Museum Inclusiveness ..... 308  
*Antonio Calandriello, Giuseppe D’Acunto, and Giulio Cesare Gigliotti*

Drawing as a Tool for Dialogue Between Technicians and Citizens:  
Practical Application in a Neighborhood of Seville ..... 316  
*Esteban de Manuel Jerez, Marta Donadei, Conso González-Arriero,  
and Ana Bravo Bernal*

Learning by Doing: Tool to Develop Skills in Digital Furniture Design  
with a 3-axis CNC Milling Machine ..... 329  
*Víctor Armas-Crespo*

Digital Models and Sensory Substitution Devices: An Inclusive  
Communication of Architecture Through Sound ..... 339  
*Salvatore Di Pace, Alfonso Ippolito, and Francisco Juan Vidal*

Building Information Modeling (BIM) for Visual Representation  
of Embodied Impacts of Buildings: Current Methods and Future Prospects ..... 351  
*Tsvetelina Spasova Bacheva and Javier Fco Raposo Grau*

An Algorithm Tool to Generate a Simplified “Digital Twin” ..... 359  
*Mara Capone, Simona Scandurra, Daniela Palomba, Gianluca Barile,  
Angela Cicala, Arianna Lo Pilato, Federica Itri, and Antonella di Luggo*

Application of Mobile 3D Data Capture Systems to the Archaeological  
Documentation of Underground Galleries in the Center of Madrid ..... 367  
*J. L. Bermudez González, E. J. Fernández Tapia,  
and E. M. Castaño Perea*

HBIM as an Active Tool for the Study of On-Paper Architecture: The Case of the Unbuilt Project for a Maritime School in Cagliari ..... 377  
*Simone Cera, Raffaele Argiolas, and Vincenzo Bagnolo*

Exploring Digital Fabrication Technologies as Potential Tools for Representation and Visualization to Support Architectural Design ..... 385  
*Covadonga Lorenzo-Cueva*

Python Script for Homographies in Rhinoceros ..... 393  
*Pau Natividad-Vivó*

Restoring Disappeared Heritage Environments. The Girona Cathedral Recontextualization ..... 401  
*Albert Sanchez Riera, Carles Pamies Sauret, and Isidro Navarro Delgado*

An Application of the Color Space to the Legibility of Maps: For the Uses, Colors ..... 409  
*Marc Roca-Musach, Isabel Crespo Cabillo, and Helena Coch*

Diffusion Models for Environment Visualization: Leveraging Stable Diffusion as a Generator for Architectural Spatial Design ..... 417  
*Pedro Meira-Rodríguez and Vicente López-Chao*

**Author Index** ..... 427



# Landscape and Heritage, Cave Dwellings, and Tourism in the Geopark of Granada as a Teaching Strategy for the Learning of Architecture

Miguel Martínez-Monedero<sup>(✉)</sup>  and Jaime Vergara-Muñoz 

Universidad de Granada, Granada, Spain  
mmartinezmonedero@go.ugr.es

**Abstract.** The initiative “Landscape, Heritage, Cave Dwellings, and Tourism” represents an ongoing teaching project at the School of Architecture in Granada since 2018. The project involves the active participation of the areas of architectural graphic expression, architectural projects, and architectural constructions. Within this framework, the task of teaching architecture has transformed into a genuine academic laboratory where diagnostics and proposals have been developed in various work areas. These have evolved into novel research projects due to the lack of rigorous prior documentation, becoming case studies that are now groundbreaking. The inclusion of cartographic contributions has been instrumental in guiding academic efforts towards student learning. This educational approach has delved into topics not previously explored in specialized literature. The educational outcomes carry a significant applicability intent, aiming to foster knowledge transfer to society at large and, particularly, to the Geopark. Moreover, they serve as a means of raising awareness about the crucial role of architecture in this distinctive territory. The continuous engagement in this dynamic teaching methodology contributes to the creation of a unique academic environment that integrates research, education, and the dissemination of valuable knowledge about the Geopark of Granada.

**Keywords:** Geopark · landscape · teacher · cultural heritage · tourism

## 1 Introduction

The present text addresses an innovative teaching strategy that aims to TEACH architecture through academic work developed in a landscape of high patrimonial value in the province of Granada: the Geopark.

This teaching strategy is based on the premise that the learning of architecture is enriched when it is developed in a real and meaningful context. The Geopark offers an exceptional environment for this, as it allows students to explore a landscape of great patrimonial and cultural value.

The teaching activity that is presented below has been developed at the ETS de Arquitectura de Granada, through the teaching levels of Degree, TFG and Master in the

subjects specific to the referred Knowledge Areas and during the academic years from 2018–19 to the present academic year 2022–2023.

At the Degree level, the strategy has been implemented in the subjects of Architectural Graphic Expression, Architectural Constructions and Architectural Projects. In the case of Architectural Graphic Expression, students have carried out works of representation of the landscapes of the Geopark, using different techniques of drawing, painting and photography. In Architectural Constructions, students have made visits to the territory of the Geopark, learning about construction techniques and materials used in the architecture of the area. In Architectural Projects, students have developed architectural projects for the Geopark, taking into account its patrimonial and cultural value.

At the TFG and Master level, students have developed research projects on the Geopark, addressing topics such as the conservation of geological heritage, sustainable development or vernacular architecture.

As a result of this coordinated work between the different areas of knowledge, the following results have been observed in the students:

- They have improved their graphic representation skills, by learning to represent the landscapes of the Geopark in a realistic and expressive way.
- They have acquired a greater knowledge of traditional construction techniques, by visiting construction sites in the Geopark.
- They have developed a greater sensitivity towards cultural and natural heritage, by working on architectural projects for the Geopark.

This teaching strategy is considered a valuable contribution to the development of architectural teaching. It offers a unique opportunity for students to learn about architecture in a real and meaningful context, and to develop a greater sensitivity towards the valuable cultural and natural heritage that we find in the Geopark.

## 2 Background

The Geopark of Granada (Fig. 1) is a territory that, due to its heritage significance, is included in the UNESCO Global Geoparks Network (July 2020). It covers an area of 4,722 km<sup>2</sup> and is located in the northeast of the province of Granada, encompassing the regions of Baza, Guadix, Montes, and Huéscar. The territory is characterized by its natural, geological, geomorphological, and Quaternary paleontological richness. Specifically, it represents the natural and cultural heritage that evolved over the centuries, featuring once-flowing rivers and lacustrine surfaces that have now disappeared from its topography. The subsequent erosion of Quaternary sediments has created landscapes of great value and spectacularity, highlighting lush valleys, ravines, depressions, and “hoyas” (large hollows in the ground) [17].

This territory is also renowned for the unique ways in which the local population has addressed their housing and accommodation needs, often through troglodytism and the well-known cave houses [7]. In other instances, they have employed a popular architecture that applies wise construction solutions honed by the passage of time and tradition [15]. These ways of life coexist with numerous archaeological spaces, of great interest yet not widely publicized, showcasing historical, artistic, natural, and cultural heritage



[4, 6]. Out of the 72 recognized Geological Sites of Interest (LIGS), approximately 2/3 still lack graphic and dimensional studies, as they lack minimal updated cartographic information [5]).



**Fig. 1.** The landscape of the Geopark of Granada, seen from the Gorafe plain. Source: Various Authors. Catalog of Landscapes of the Province of Granada. Provincial Council of Granada 2010.

### 3 Discussion

From the outset, the chosen approach not only met the educational requirements outlined by the respective areas of knowledge but also evolved into a research laboratory. This laboratory serves as a platform for conducting studies and diagnostics of selected work areas, with cartographic contributions (surveys) playing a pivotal role in academic endeavors aimed at student learning.

It is evident that this teaching dynamic engages with a territory of significant singularity and heritage value. The knowledge generated in the study areas provides novel documentation not found in specialized literature. Thus, the teaching work takes on a prominent applicability intent. By disseminating the results, it promotes knowledge transfer to society and raises awareness about the importance of this heritage.

The teaching approach involves the incorporation of content and themes specific to architectural education, previously unexplored in this landscape. The aim is to systematize a methodology for representing and documenting cultural and heritage landscapes in this territory, involving various work dynamics related to the mentioned areas of knowledge. These dynamics include on-site knowledge trips, on-site drawing, site measurement, surveying, territory registration, toponymy study, bibliographic documentation, the use of cartographic documentation techniques through massive point captures, and finally, the architectural representation of obtained data and map production.

Collectively, this approach provides a representation of the territory, its history, and architecture, serving as a documentary foundation for the subsequent teaching work. The process began with an understanding of the entire heritage territory of the Geopark, gradually narrowing down to different selected areas for various reasons. Various lines of research have been proposed within these areas, unified by the intention of achieving

valuable and applicable results, ultimately aiming to facilitate the transfer of knowledge to society.

## 4 Results

The educational projects undertaken have been organized into three major groups, corresponding to the teaching lines focusing on the landscape of the Geopark: 1) Landscape and Architectural Heritage; 2) Cave Dwellings, Troglodytism, and Traditional Architecture; and 3) Interventions in Tourist Sites.

The production of cartographies and documentary materials, serving as the basis for each study, was carried out collaboratively. Beginning with a comprehensive study of the territory conducted by the research group (Fig. 3), each subgroup tackled a specific theme for their investigation. The themes were designed to address the academic requirements of the three involved areas of knowledge (Architectural Graphic Expression, Architectural Projects, and Architectural Constructions). The following is an excerpt of the results obtained:

### 4.1 Landscape and Architectural Heritage: The Geopark Landscape

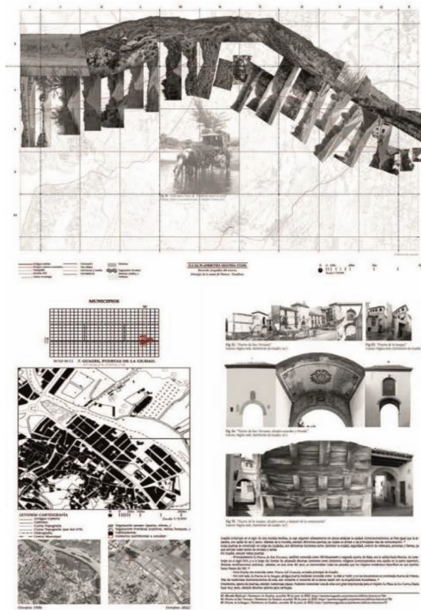
The strong heritage characterization of the Geopark territory has motivated the choice of the various work places. These were located in the towns of Diezma, Zújar, Minas de Alquife, Cúllar and Hoya de Baza. In Diezma, a cartographic approach to a historical and heritage path was carried out [3] (Fig. 2); In Zújar, a proposal was made to study the peri-urban environment of its population, with the intention of making proposals to improve the landscape [2]; In Minas de Alquife, a chronotope and architectural survey of its mining town was studied [13]; and finally, in Cúllar and Hoya de Baza, a landscape study was carried out through its different scales of understanding [9].

### 4.2 Cave Dwellings, Troglodytism and Traditional Architecture of the Geopark

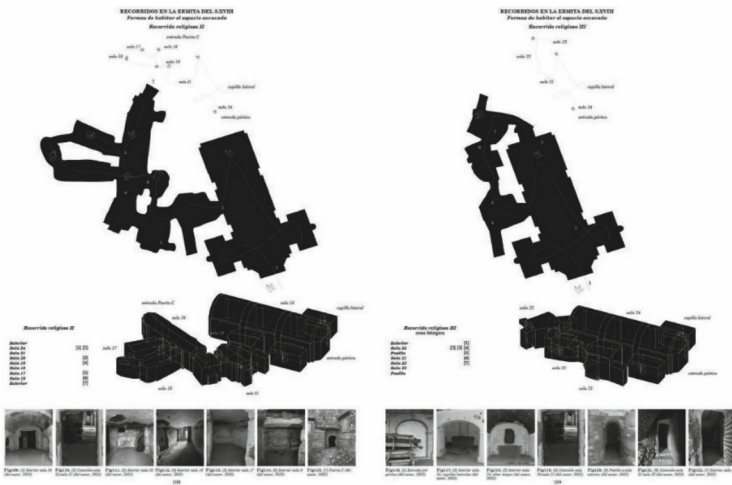
This theme was the argument that led 3 interesting works whose line of research was based on excavated architecture, a very widespread way of life in this territory. These works were located in the Huéscar region, the Face-Retama plain and Gorafe. In Huéscar, its interesting architecture of cave houses was studied [1]; in Face-Retama the popular sanctuary of San Torcuato [14] (Fig. 3); and finally, in Gorafe an excavated oil mill was investigated [8] (Fig. 4).

### 4.3 Actions in Enclaves of Tourist Interest in the Geopark

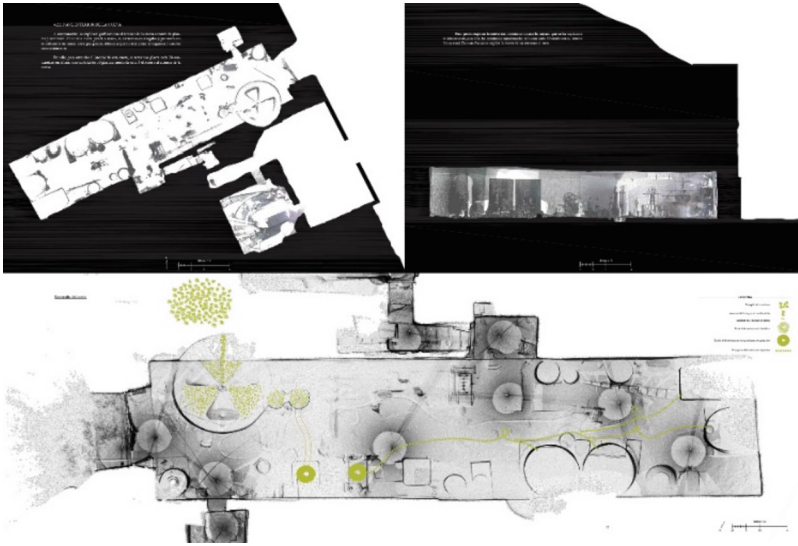
This line of research has been carried out by works located in the towns of Guadix, Cortes and Graena, in the Negratín reservoir, and in the different hydrothermal spaces intended for spas in this territory. In Guadix, a study was carried out on the possible location of an Interpretation Center in its Alcazaba [17]; A Visitor Center was planned in the Negratín reservoir [12] (Fig. 5); another Interpretation Center was studied in the town of Cortes y Graena [16]; and finally, the spa infrastructure, with other services, was located in different enclaves of the Geopark [4, 10, 11].



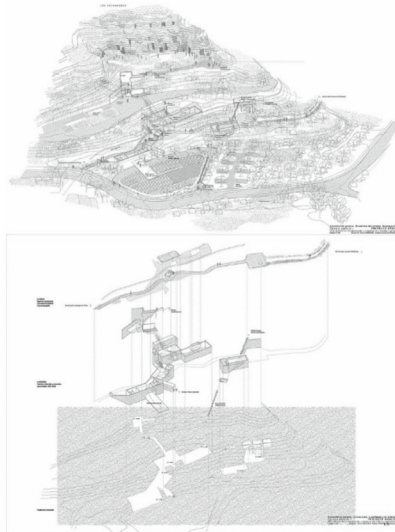
**Fig. 2.** Data record from the academic research work: ‘Note on a Walked Landscape, Cartographic Approach to the Historical Path Cuesta de Diezma. Source: Castro Valderas, 2022. Bachelor’s Thesis, School of Architecture of Granada.



**Fig. 3.** Data record from the academic research work: ‘The Sanctuary of San Torcuato, Emptiness as Construction in the Plain of Face Retama’. Source: Teresa Moya, 2022. Bachelor’s Thesis, School of Architecture of Granada.



**Fig. 4.** Data record from the academic research work: “The Productive Cave, Analytical Cartography of an Olive Oil Mill Excavated in Gorafe”. Source: Padorno Barranco, 2022. Bachelor’s Thesis, School of Architecture of Granada



**Fig. 5.** Center for Interpretation and Studies of Troglodyte Habitat in Cortes (Granada). Source: Elena Ruiz, 2023. Master’s Thesis, School of Architecture of Granada

## 5 Conclusions

The proposed teaching lines, in addition to meeting the requirements set by the respective areas of knowledge, were organized as a research laboratory on which to carry out diagnoses of the multiple problems of the chosen work areas. They are case studies assumed as research papers in which the cartographic contribution is of great interest.

The works were framed in 3 large groups that correspond to teaching lines of action on the landscape and territory of the Geopark:

- Landscape and architectural heritage: This group of works focused on the study of the heritage values of the Geopark landscape, including vernacular architecture, historical monuments, and natural spaces. Research, documentation, and graphic representation of the landscapes and monuments of the Geopark were carried out.
- Cave dwellings and traditional architecture: This group of works focused on the study of cave dwellings and traditional architecture in the Geopark. Research, documentation, and restoration of cave dwellings and other traditional buildings were carried out.
- Interventions in tourist attractions: This group of works focused on the study of tourism interventions in the Geopark. Students carried out research, design, and execution of tourism intervention projects in the Geopark.

The knowledge generated in the study areas is innovative work that addresses topics not yet addressed by the specialized literature and that maintains an intention of applicability through its dissemination. Therefore, the teaching results have been uploaded to open university digital repositories. This achieves the transfer of knowledge to society in general, as well as being a factor in raising awareness of the importance of architecture in this territory.

## References

1. Aguilera Delgado, A.: La casa invisible, patrimonio excavado en la comarca de Huéscar. TFG ETS de Arquitectura de la UGR. Universidad de Granada, Granada (2019)
2. Alcántara Moral, M.: Análisis y propuesta de mejora arquitectónica en el paisaje periurbano de Zújar, en el ámbito del Geoparque de Granada. TFG ETS de Arquitectura de la UGR. Universidad de Granada, Granada (2022)
3. Castro Valderas, J.: Apunte de un paisaje andado, aproximación cartográfica al camino histórico “Cuesta de Diezma.” TFG ETS de Arquitectura de la UGR. Universidad de Granada, Granada (2022)
4. García Herráiz, R.: Proyecto de aprovechamientoturístico de los recursos patrimoniales de la comarca de Guadix. Tesis doctoral, UGR. Universidad de Granada, Granada (2020)
5. Granados Salazar, D.: Geodiversidad: red de geoparques de Andalucía, Diputación de Granada, Granada (2022)
6. Líndez Vílchez, B.: La construcción de la memoria del paisaje. paisajes construidos, paisajes con memoria. Tesis doctoral, UGR. Universidad de Granada, Granada (2016)
7. Martínez Olivencia, R.: Reformasen las cuevas de la comarca de Guadix. propuesta de revalorización de desechos de tierra. Editorial UGR. Universidad de Granada, Granada (2013)
8. Padorno Barranco, N.: La cueva productiva, cartografía analítica de una almazara excavada en Gorafe. Diputación de Granada, Granada (2022)

9. Pérez Ruiz, J.: Las escalas del paisaje de Cúllar de las Sierras a la Hoya de Baza. TFG ETS de Arquitectura de la UGR. Universidad de Granada, Granada (2023)
10. Rascón Sánchez, M.A.: Manantiales e hidrotermalismo: las aguas minero-medicinales y termales como recurso geoturístico del Geoparque de Granada. Tesis doctoral, UGR. Universidad de Granada, Granada (2019)
11. Rosúa Luna, A.: Proyecto de interpretación del cine en la comarca de Guadix. Editorial UGR. Universidad de Granada, Granada (2021)
12. Ruiz Hermoso, B.: Centro de visitantes del altiplano de Granada embalse del Negretín. TFG ETS de Arquitectura de la UGR. Universidad de Granada, Granada (2019)
13. Sánchez Ruiz, J.M.: Crono-localización y caracterización del Poblado de Minas de Alquifeen el entorno del Geoparque de Granada. TFG ETS de Arquitectura de la UGR. Universidad de Granada, Granada (2023)
14. Teresa Moya, M.: El santuario de San Torcuato, el vacío como construcción en la planicie de face Retama. TFG ETS de Arquitectura de la UGR. Universidad de Granada, Granada (2022)
15. Ubago Palma, S.: Arquitectura dispersa en Andalucía oriental (Huéscar, Cogollos Vega, Contraviesa). Territorio, paisaje, lugar. Tesis doctoral, UGR. Universidad de Granada, Granada (2019)
16. VVAA: Centro de Interpretación del Hábitat Troglodita en Cortes (Granada). TFM 2022–2023, ETS de Arquitectura de Granada. Universidad de Granada, Granada (2023)
17. VVAA: Parque arqueológico y centro de interpretación de la alcazaba de Guadix. TFM 2021–2022, ETS de Arquitectura de Granada. Universidad de Granada, Granada (2022)