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3D MODELING, SUSTAINABILITY AND JEWELRY DESIGN. A SYSTEMATIC LITERATURE REVIEW

Modelado 3D, sostenibilidad y diseño de joyas. Una revisión bibliográfica sistemática

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ABSTRACT

This paper proposes a systematic literature review (SLR) as a continuation of the research on gemstone drawing, building upon the outcomes of previous research conducted by the authors and expanding the field of inquiry to include sustainability issues in gemmology. The review conducted in order to analyze scientific contributions consistent with the international discussion on sustainability, also according to the Sustainable Development Goals, was limited to publications from the last decade. Having defined the specific areas of focus, as much related to the disciplinary field of design as to gemmology and sustainability, a qualitative-quantitative analysis was conducted on more than 700 articles. The analyses allowed the authors to discuss the geographical distribution of authors and the keywords identified, as well as to propose in-depth focuses for the categories "eco-design," "gemmology," "promotion," and "innovation." In particular, the latter noted how technological innovation applied to digital modeling can bring significant benefits to gemmology from a sustainability perspective, offering interesting insights for future development of the present research.

KEYWORDS

Drawing; geometry; parametric model; gemstone; conscious design

RESUMEN

Este artículo propone una revisión bibliográfica sistemática como continuación de la investigación sobre el diseño de piedras preciosas, partiendo de los resultados de las investigaciones ya realizadas por los autores y ampliando el campo de investigación a las cuestiones de sostenibilidad en el ámbito de la gemología. La revisión realizada con el fin de analizar las contribuciones científicas coherentes con el debate internacional sobre las cuestiones de sostenibilidad, también en consonancia con los Objetivos de Desarrollo Sostenible, se limitó a las publicaciones de la última década. Una vez definidos los campos de estudio específicos, tanto los relacionados con el ámbito disciplinar del diseño como con el de la gemología y la sostenibilidad, se realizó un análisis cualitativo-cuantitativo de más de 700 artículos. El análisis permitió discutir la distribución geográfica de los autores y las palabras clave identificadas, así como proponer enfoques en profundidad para las categorías «ecodiseño», «gemología», "promoción" e «innovación». En particular, esta última señaló cómo la innovación tecnológica aplicada a la modelización digital puede aportar importantes beneficios a la gemología en términos de sostenibilidad, ofreciendo interesantes perspectivas para el desarrollo futuro de esta investigación.

PALABRAS-CLAVE

Dibujo; geometría; modelo paramétrico; piedra preciosa; diseño consciente

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1. INTRODUCTION

This study addresses the topic of gemstone drawing with a specific focus on sustainability issues related to the gemological market. In this area, the increasing attention to sustainability principles has directed the use of synthetic gemstones (so-called lab-grown) and the optimization and recutting of existing ones, also with reference to the negative environmental and social fallout associated with the mining and processing of both precious metals and gemstones. Recent studies by Imperial College London (Oluleye, 2021) have in fact quantified the environmental impact related to the mining of precious stones, in different geographical areas, with reference to the increasing values of pollutants emitted into the air, soil or water, as well as highlighting the social impacts in this area mainly related to a lack of protection of workers' human rights (Fig. 01).

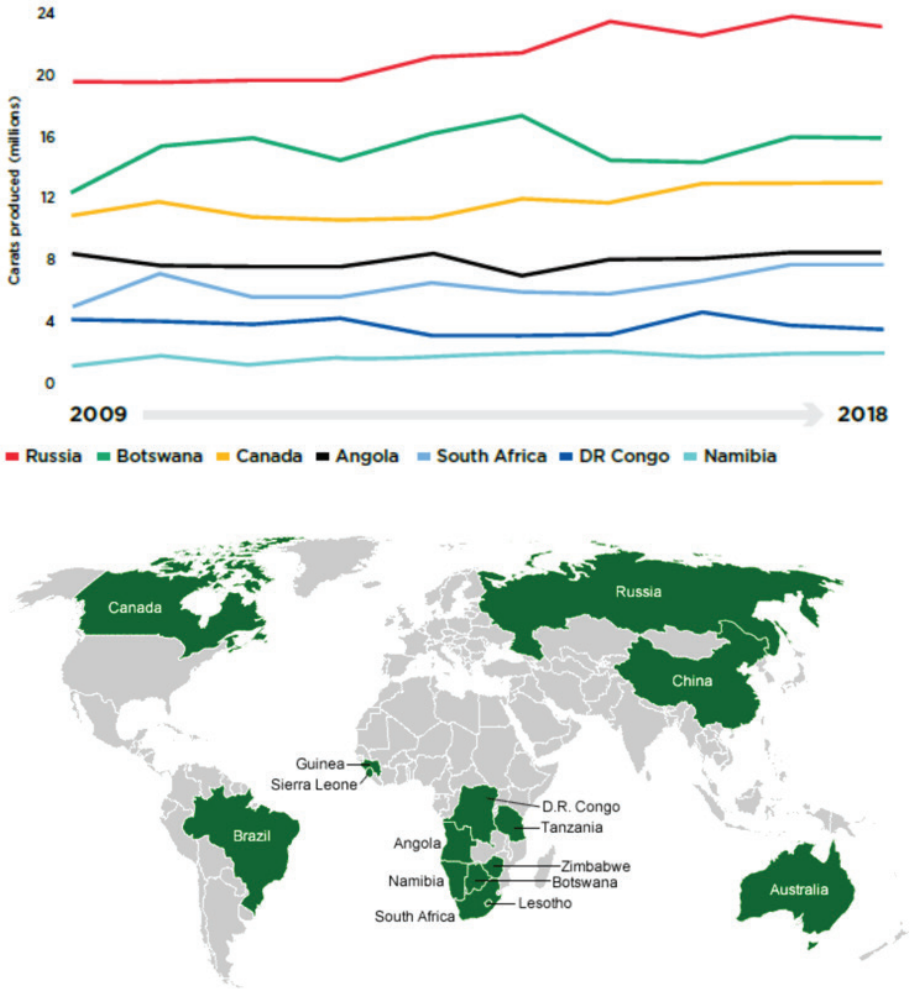

Fig. 1
Diamond production in the main geographical areas of extraction from 2009 to 2018 (top). Nations with a mining of at least 50000 carats of diamonds/ year (bottom). (Source: Oluleye, 2021).

Starting on research conducted by the authors on the topic of gemstone drawing and analog and digital models in the gemological field (Pisacane et al., 2024), this study aims to highlight the sustainability advantages of digital modeling both for geometric-dimensional type analysis and gemological characteristics of existing raw and cut stones, as well as for the conception, design and communication of the finished product (Figs. 02-03).

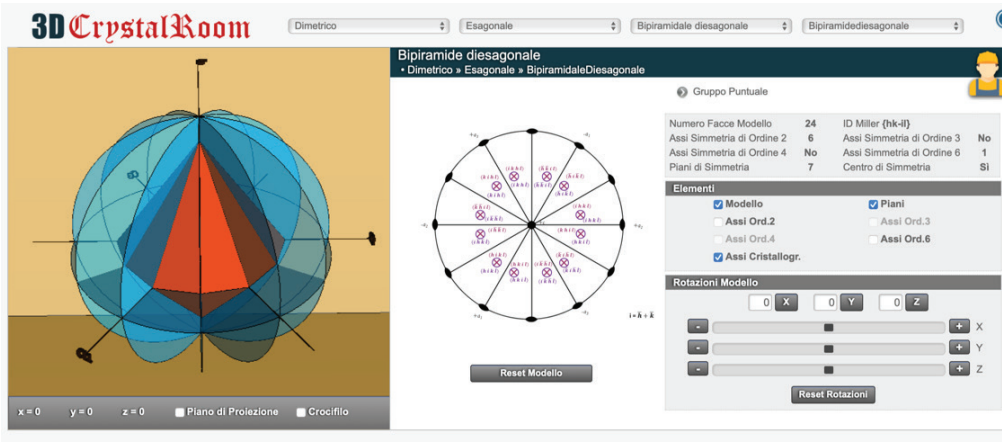

Fig. 2
The crystal form of the di-hexagonal bipyramid. Digital model and stereogram processed in the 3DCrystalRoom software (University of Bari) (top). Digital elaboration by Authors

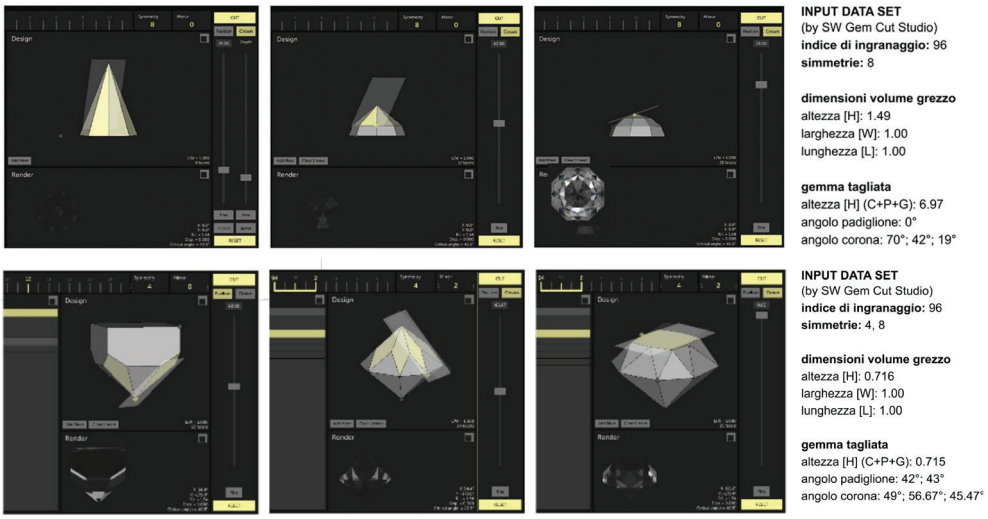

Fig. 3
Digital models of faceted gems processed in Gem Cut Studio software. Elaboration by the Authors.

Not only geometric but also parametric modeling supports all stages of analysis and design. At the atomic scale, it allows, on the one hand, the definition of mineralogical structures in relation to the analogy between natural and synthetic gems to ensure the yield of the latter is perfectly comparable to those obtained on natural stones and, on the other hand, the knowledge of the crystal structure for the cutting of existing gemstones to optimize the use and yield of the precious material. At the scale of the object, it both directs the design choices for determining the desired shape in order to reduce the waste of precious material while maintaining high levels of brilliance, and allows the construction of predictive virtual models for their high verisimilitude with the physical design models in order to simulate the rendering of both the faceted stone and the jewel setting and its aesthetic effect and wearability in relation to the body. In addition, again at the scale of the object, jewelry parametric models foster product knowledge in a virtual environment for both scientific disclosure and commercial purposes. For the former, through the setting up of exhibitions of existing objects, thus avoiding the economic-environmental implications related to their displacement from their places of origin and digital reconstructions of jewelry no longer available, and for the latter, through the promotion of products by making use of collections and displays in the virtual environment.

Starting from these premises, the present study, having assumed the privileged role that models, including parametric models, have in the specific disciplinary field of design, and having extended its centrality also in the sustainability of choices in both the analysis and design phases, proposes a literature review of the most recent studies on the subject to discuss the most original experiments and to orient future studies towards the most innovative scenarios of modeling in a digital environment declined in a sustainable key.

The next two paragraphs discuss the outcomes of the literature review. Specifically, the first paragraph describes the construction of the research model and critically analyzes the geographic distribution of the authors of the studies and the keywords identified; the second paragraph describes the quantitative and qualitative analysis conducted and, having identified thematic categories, delves into the distribution of studies among them.

2. LITERATURE SEARCH PARAMETERS IN THE SLR REVIEW PROCESS AND DATA VISUALIZATION

A systematic literature review allows for the identification and evaluation of the existing body of knowledge on a specific topic (Fink, 2019) from which to select the most advanced concepts in the field of discussion. The analysis conducted made use of scientific literature data extracted from Scopus, Web of Science (WoS) and Science Direct databases through specific search queries based on keywords appropriately identified in relation to specific subject areas.

The first area concerns the discipline of drawing and its insights into configurational geometries and parametric modeling. The second scope concerns an in-depth study of applications in the gemological field of the first scope. Finally, the third scope limits the first two to sustainability issues. The in-depth scopes were translated into the following search key "(model* OR drawing OR geometry* OR parametric*) AND (gemstone OR gem*olog*) AND Sustainability," as input data entered into the aforementioned scientific databases. The search was extended to all fields, given the specificity of the identified keywords. The search key construction syntax made use of the "AND" operator to ensure contextual searches in the three identified fields. The "OR" operator allowed the different declinations of the words model, drawing, geometry, and parametric to be excluded for the field related to representation. The same operator made it possible to exclude the domain connected with nature and crystal processing, the different declinations of both gemstones, and the disciplines that study them. The transversality of sustainability-related aspects did not require the operator "OR."

These queries aim to identify articles published from 2015 to the present, limiting the search to scientific studies that have addressed the specific topic of sustainability in line with the goals of Agenda 2030. In addition, this time range allows only studies that make use of the latest digital modeling technologies in gemology to be included in the analysis, thus narrowing the scope of the review to literature from the disciplinary field of design. Specific disciplinary interests filtered the search within the fields provided by the scientific databases to only the fields of "Environmental Science, Social Sciences, Engineering, Computer Science, Earth and Planetary Sciences, Materials Science, Chemical Engineering, Chemistry, Mathematics, Arts and Humanities", thus excluding studies from other fields, such as "Business, Management and Accounting, Agricultural and Biological Sciences, Economics, Econometrics and Finance, Energy, Physics and Astronomy, Biochemistry, Genetics and Molecular Biology". An additional filter related to the English language was applied to these queries, given its prevalence in the scientific literature (Fig. 4).

Source Databases	Scopus, Web of Science (WoS) e Science Direct
Search String	(model* OR drawing OR geometry* OR parametric*) AND (gemstone OR gem*olog*) AND Sustainability
Time Period Restriction	2015 - 2025
Article Types	Journal, Conference Paper, Book Chapter, Review
Language Restriction	English
Included Subject Areas	Environnmental Science, Social Sciences, Enngineering, Computer Science, Earth and Planetary Sciences, Materials Science, Chemical Engineering, Chemistry, Mathematics, Arts and Humanities
Excluded Subject Areas	Business, Management and Accounting, Agricultural and Biological Sciences, Economics, Econometrics and Finance, Energy, Physics and Astronomy, Biochemistry, Genetics and Molecular Biology

Fig. 4
Literature search parameters in the literature review process.

The initial focus is on the Scopus database, which produced a total of 436 records, followed by other databases, which produced another 377 articles, including 373 on Science Direct. Through the VOSviewer application, representative maps of the bibliographic data extracted from the databases were generated. Specifically, the software allows selection of types of analysis and units of analysis from the bibliographic data by returning them in several possible graphical displays. In the specifics of this study, elaborations were conducted with respect to the type of analysis by author and by occurrences. With respect to the type of analysis by author of the papers, the unit of analysis delved into their geographic origin in order to verify their possible connection with the main extraction sites; for the type of analysis related to occurrences, the unit of analysis selected was the keywords identified by the authors in the individual scientific publications to map their recurrence and possible connections with other keywords. Both types of analysis were themed relative to the year of publication.

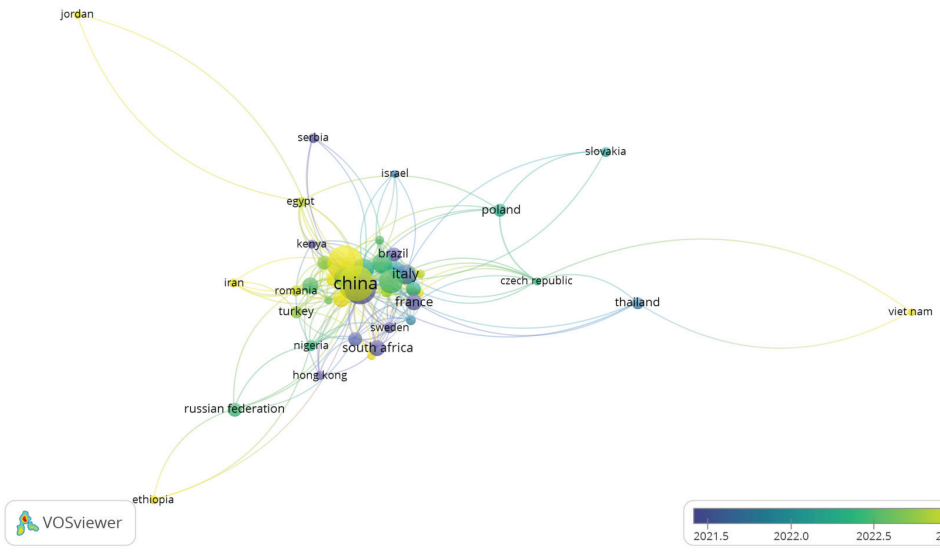

Fig. 5
Authors countries clustering analysis on bibliographic data. Digital elaboration by the Authors in VOSviewer.

Figure 5 shows that among the forty-five countries of origin of the authors, the most significant percentages come from China with eighty-six publications, and India with eighty-five. Significantly lower is the presence of scientific articles in the other countries. Comparing this analysis with the graph in Figure 1 shows the overlap between the countries where most of the studies are conducted and those where there are the main mining sites of precious from which there is a clear scientific sensitivity in the countries where mining is most active.

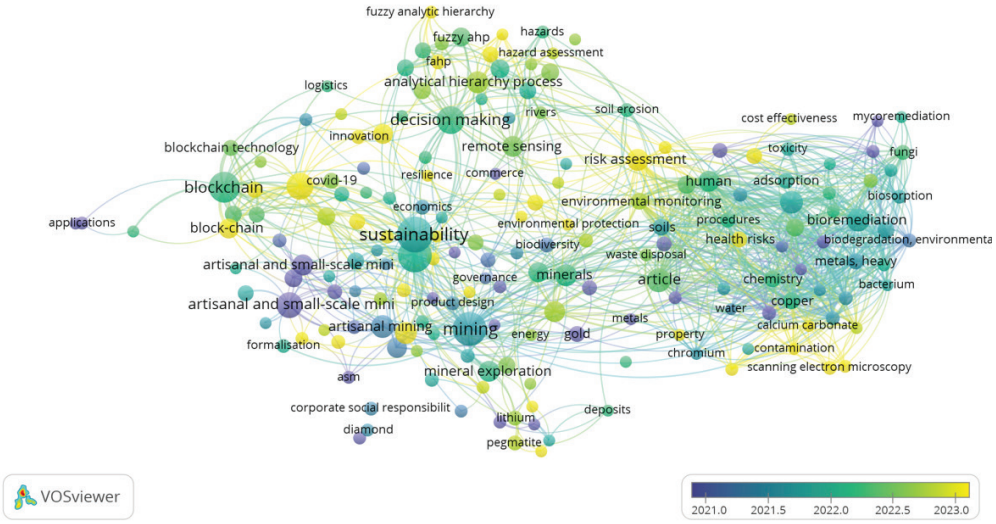

Fig. 6
Keywords clustering analysis on bibliographic data. Digital elaboration by the Authors in VOSviewer

In Figure 6 on the distribution of keywords in the different selected articles, a high percentage of occurrence of the words "sustainability" and "mining", followed by "blockchain", "minerals" and "decision making" clearly emerges. Next, a match was made between the keywords in the papers and those selected in this study for the review queries. It is shown on the one hand the absence of those related to the research scope of the specific discipline of representation, on the other hand, the connections between the words "sustainability" and "gemstone" with each other and with the other keywords. The word "gemstone" (Fig. 7), least present as a keyword among the identified articles, shows noteworthy connections to "sustainable development" and "environmental impact" as well as to "blockchain" technology.

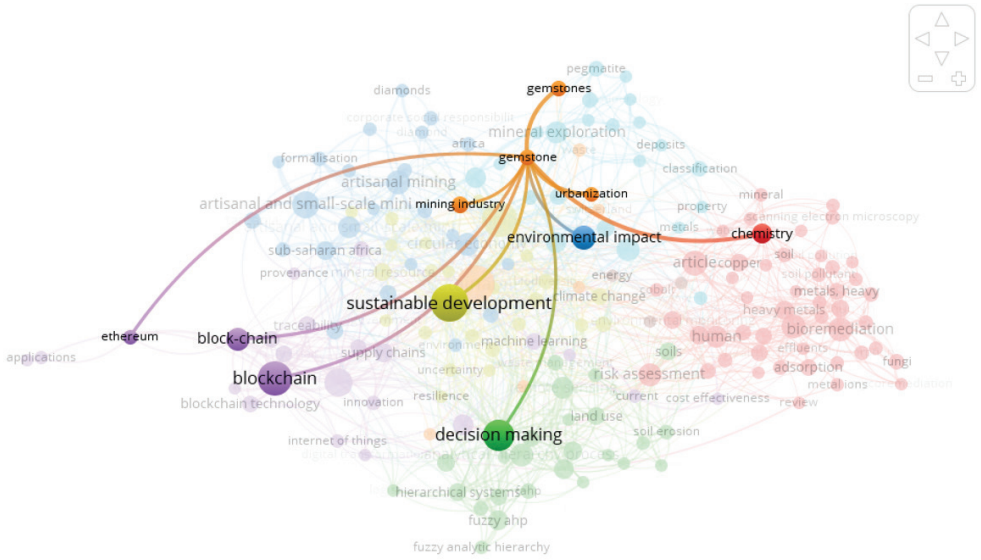

Fig. 7
Keyword "gemstone" clustering analysis on bibliographic data. Digital elaboration by the Authors in VOSviewer.

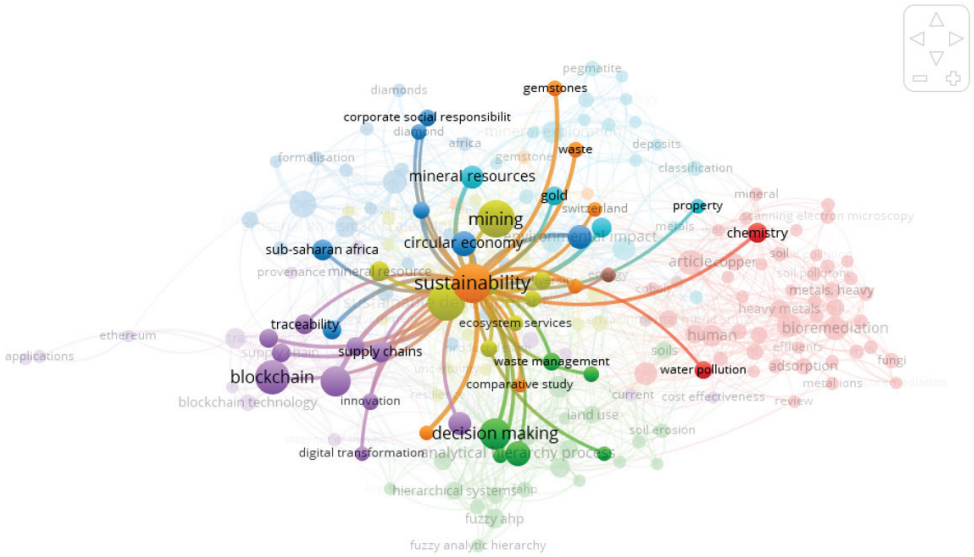

Fig. 8
Keyword "sustainability" clustering analysis on bibliographic data. Digital elaboration by the Authors in VOSviewer.

The word "sustainability" (Fig. 8) shows obvious connections with those directly related to its various declinations in the social, economic and ecological domains. In addition, its connections to the keywords related to its applications in mineralogy and gemology and its developments in the digital environment further confirm the cross-cutting nature of the study being conducted in the three areas of research, validating the direction of in-depth study initiated with the present study and its subsequent developments.

3. QUALITATIVE AND QUANTITATIVE ANALYSIS IN THE PRISMA RESEARCH APPROACH

The systematic review of the scientific literature begins with an exploratory survey, which employs both qualitative and quantitative analysis techniques, following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodological approach (David, 2023). Quantitative analysis provides a statistical overview of the relevant research papers; in parallel, qualitative analysis categorizes the research papers according to the objectives of sustainable optimization of natural and synthetic gemstone processing in the digital environment through modeling, including parametric modeling in both the analysis and project phases.

The records extracted from the scientific databases were exported to HubMeta tool (Steel, 2023) for the subsequent qualitative-quantitative analysis phase.

The HubMeta online platform provides a valuable support for bibliographic analysis in science by replicating in the digital environment the steps of critical appraisal of scientific literature through a multi-step process that leads to an evaluation and selection of useful articles to answer focal questions.

In this study, the data exported from the scientific databases Scopus, Web of Science (WoS) and Science Direct are related to the "Citation information" and "Abstract & keywords" sections of which all available information is acquired. In total, data were collected for 799 papers, from which through successive screening processes 20 duplicate results were removed, for a total of 779 articles. The HubMeta platform allows for the "Title screening" phase to reject, accept, or defer the possible selection of articles in the subsequent "Full Text screening" phase. The initiation of this operation has set the conditions to train the AI assistant internal to the same platform allowing the selection to continue through the percentage value of relevance of each publication provided from time to time by the AI Comment. Such support streamlined the evaluation processes by reducing the time for

product selection.

The next step involved the inclusion or exclusion of literature through the review for each article of the title and abstract. At the conclusion of the evaluation process, 706 products were excluded. Forty-two of the 73 accepted ones are referred to full text evaluation to complete the literature review (Fig. 9). The outcomes of this process are depicted in the block diagram in Fig. 10, which returns data from the "Identification" and "Screening" stages by deferring the "Elegibility" and "Included" stages to later stages of the search.

ID	Title	Year
1	The Evolution of Corporate Innovation in the O2O ModelCase Studies in the Chinese Jewelry Retail Sector	2023
2	Predictive Modelling of Customer Sustainable Jewelry Purchases Using Machine Learning Algorithms	2024
3	Optimization design model construction of round faceted gemstone facets based on geometric transformation theory	2025
4	Creative Transformation and Value Realization of Artificial Intelligence in Jewelry Design Field	2024
5	Lab-Grown DiamondThe Shape of Tomorrows Jewelry	2021
6	From Image to Imagination: Exploring the Impact of Generative AI on Cultural Translation in Jewelry Design	2023
7	Can CSR influence Chinese consumers intention to purchase jewelry ethically? The moderating effect of eWOM based on the SOR model	2024
8	Corporate environmental assessment of a large jewelry company: From a life cycle assessment to green industry	2017
9	Optimizing eco-friendly jewelry design through an integrated eco-innovation approach using artificial neural networks	2025
10	Resilient closed-loop supply chain network design considering quality uncertainty: A case study of stone quarries	2023
11	Diamonds, Development, and Dollars: A Case Study on a Newly Founded Gemological Lab in Botswana Aiming at Sustainable Community Empowerment	2017
12	Enhancing Gemstone Classification Accuracy: A Deep Learning Approach Using CNN, VGG-19, and Xception	2024
13	Research on Sustainable Development of Tourism Resources in Abandoned Gemstone Mining Areas with Big Data Technology: A Case Study of Turquoise Mining in Yungui Temple Area	2023
14	The Integration and Design of Green Concept in Jewelry under the Background of Information Technology	2023
15	Influence of business model and marketing environment of Thai gems and jewellery during COVID-19 pandemic: opportunities and challenges	2024
16	Color and local heritage in gemstone branding: A comparative study of blue zoisite (Tanzanite) and color-change diaspore (Zultanite/Csarite)	2019
17	Experimental Study for the Valorization of Polymeric Coffee Capsules Waste by Mechanical Recycling and Application on Contemporary Jewelry Design	2021
18	Georesources as an Alternative for Sustainable Development in COVID-19 TimesA Study Case in Ecuador	2022
19	Emancipatory technology and supply chains: A case study of African women gemstone miners	2022
20	Gemstone supply chains and development in Pakistan: Analyzing the post-Taliban emerald economy in the Swat Valley	2019
21	Modeling mining-induced land degradation in Itagunmodi: A multi-temporal machine learning approach with random forest and gradient boosting	2025
22	NFT Certificates and Proof of Delivery for Fine Jewelry and Gemstones	2022
23	Building field trips to small scale mines into university undergraduate degrees: The case of gemstone extraction in Sri Lanka	2022
24	Chapter 1.6.5 - Botswana's Untold Story of the Kalahari Dust Bowl to a Mecca of Diamond Mining	2025
25	Which visual elements on packaging affect perceived credibility? A case study of in vitro diagnostic kits	2023
26	Development of 3D-printed Cultural Products Using Yuan Blue and White Porcelain Patterns	2024
27	Gems Recovered from Sedimentary Rocks	2023
28	Mineral identification based on natural feature-oriented image processing and multi-label image classification	2024
29	Effect of pressure on large size diamond single crystal synthesized by temperature gradient method under low nitrogen condition	2023
30	Artificial Intelligence and Virtual Reality-Based Interactive Training Cum Education System	2025
31	Fabrication and evaluation of monolayer diamond grinding tools by hot filament chemical vapor deposition method	2019
32	Mineral deposits: host rocks and genetic model	2020
33	Saving temporary exhibitions in virtual environments: The Digital Renaissance of Ulisse Aldrovandi Acquisition and digitisation of cultural heritage objects	2024
34	Zimbabwe's coloured gemstone endowments - A regional geological overview	2024
35	Production of Aerated Foamed Concrete with Industrial Waste from the Gems and Jewels Sector of Rio Grande do Sul-Brazil	2017
36	Stakeholder Engagement in Sustainability Innovation: Experiences in the Jewellery Business	2016
37	Visual Perception and Cognition by the Means of Interactive Digital Replicas of Museum Artifacts: Leonardo da Vincis Drawings as If They Were in Visitors Hands	2022
38	The role of artisanal mining in the sustainable development of Myanmars jadeite industry	2021
39	Progress towards 3D-printing diamond for medical implants: A review	2021
40	Determinants of Online Behavior Among Jordanian Consumers: An Empirical Study of OpenSooq	2022
41	It can lift someone from poverty: Imagined futures in the Sierra Leonean diamond market	2018
42	Rushing for gemstones and gold: Reflecting on experiences from the United States, Canada, New Zealand, Australia and Madagascar, 1848-present	2019
43	A framework for integrating sustainable production practices along the product life cycle	2025
44	The role of Ethiopian government in promoting corporate social responsibility in mining sector	2025
45	Sustainable supply chain management for minerals	2017
46	Geodiversity: a significant, multi-faceted and evolving, geoscientific paradigm rather than a redundant term	2021
47	Ethical Sourcing and Decision Making in the Fashion Industry: A Longitudinal Qualitative Examination	2025
48	A Modern History of Materials	2023
49	Digital extraction: Blockchain traceability in mineral supply chains	2021
50	A supervised multiclass framework for mineral classification of Iberian beads	2024
51	Design and evaluation of an ergonomic polisher for handcrafted polishing workers in north-east India	2022
52	Exploring emerald global geochemical provenance through fingerprinting and machine learning methods	2024
53	Is the digitalisation the future of the luxury industry?	2024
54	Freshwater Ecosystem Services in Mining Regions: Modelling Options for Policy Development Support	2018
55	Selection of Quality Gemstones Based on Fuzzy Analytical Hierarchy Process	2023
56	Luxury supply chain management: a framework proposal based on a systematic literature review	2021
57	Mapping to explore the challenges and opportunities for reconciling artisanal gem mining and biodiversity conservation	2023
58	Recent developments in techniques and technologies for analytical, spectroscopic, structural, and morphological characterization of modern materials of advanced applications	2024
59	Geo-environmental and socio-economic impacts of artisanal and small-scale mining in Ethiopia: challenges, opportunities, and sustainable solutions	2025
60	Diamond growth and properties for quantum technologies	2025
61	Minerals and rocks	2020
62	The chemistry of making color in art	2021
63	A Brief History of Colour, the Environmental Impact of Synthetic Dyes and Removal by Using Laccases	2021
64	Predicting the rock cutting performance indices using gene expression modeling	2024
65	International trade in rough diamonds and the Kimberley Process Certification Scheme	2022
66	A doubleedged sword: Realities of artisanal and smallscale mining for rural people in the Alaotra region of Madagascar	2021
67	Material-Oriented Cutting Processes in Precision Machining	2025
68	History of Geology	2021
69	Recent advances in blockchain technology: prospects, applications and constraints in the minerals industry	2024
70	3 - Abrasives	2025
71	Analysis of Brazilian fashion sectorial brand identity	2018
72	Geoheritage and Museums	2018
73	Elements of Mining	2018

Fig. 9
Report of selected articles after "Title screening" phase. Elaboration by the Authors.

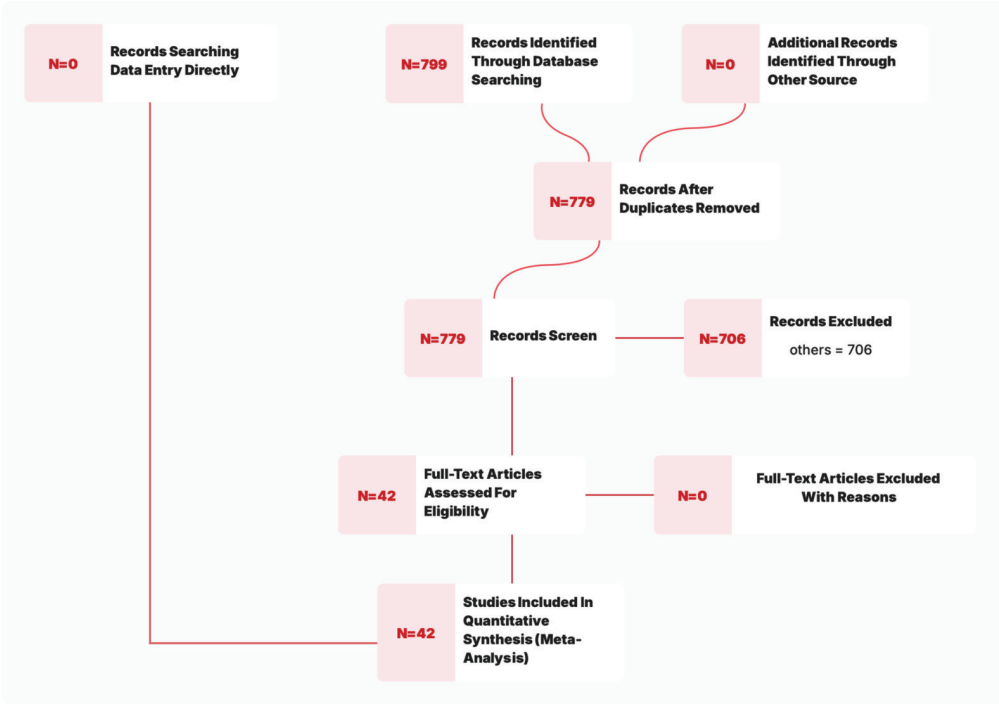

Fig. 10
Flowchart of the systematic literature review according to PRISMA research approach. Elaboration by the Authors in HubMeta.

In the period taken as a reference, the quantitative analysis returned a significant increase from the year 2021 onward, confirming also in the scientific field the centrality and topicality of the sustainable approach to this issue, both in theoretical declinations and in applications with the latest digital technologies (Fig. 11).

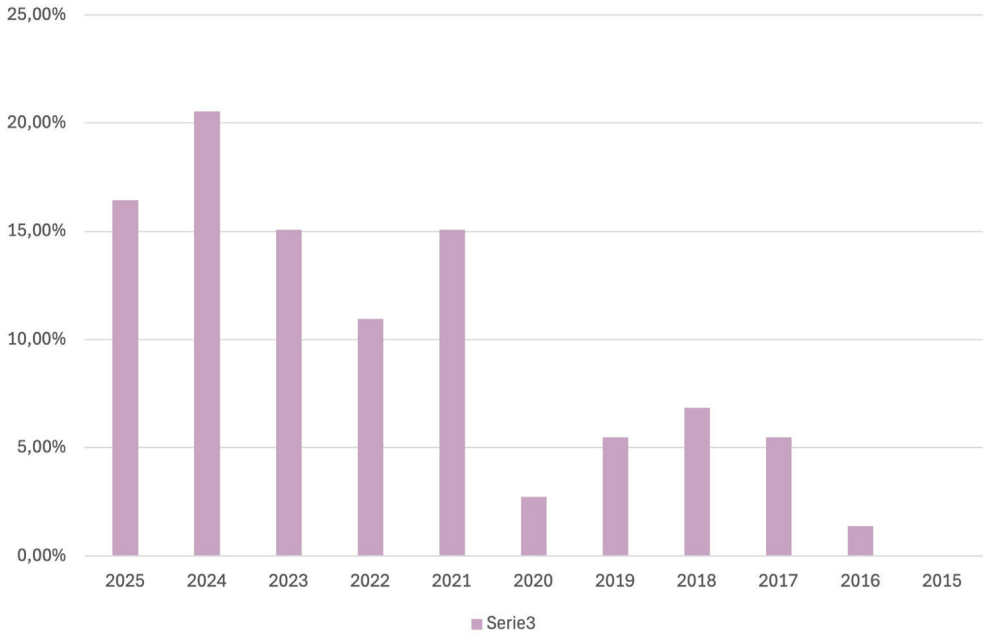

Fig. 11
Percentage of selected articles per year between 2015-2025. Elaboration by the Authors.

Following the quantitative analysis, we moved on to the qualitative analysis of the selected articles by identifying four thematic categories in line with the in-depth focuses. For a more in-depth qualitative investigation, each category was divided into multiple subcategories into which the studies selected in the previous phase fall. The four thematic categories decline the themes of gemmology, promotion, eco-design and innovation from a sustainable perspective (Fig. 12).

Category	Sub-Categories	%	Relevant Literature
Eco-design	Raw gems extraction	27,4	[2,5,7,8,9,10,11,13,17,19,20,21,23,24, 32,34,35,38,39,41,42,43,44,45,46,51, 54,57,59,62,63,64,66,70,71]
	Jewelry design	13,7	
	Conscious consumer	6,85	
Gemmology	Mineralogy studies	16,44	[12,15,16,18,27,28,29,31,47,52,55,56, 58,60,61,67,68,72,73]
	Lab grown gemstones	4,11	
	Gemstones demand during COVID-19 emergency	2,74	
	Gemstones quote	2,74	
Innovation	Geometry, modeling and 3D printing	8,22	[3,4,6,14,22,26,30,48,49,50,53,65,69]
	Blockchain applications	6,85	
	AI applications	2,74	
Promotion	Visual design and communications	5,48	[1,25,33,36,37,40]
	Exibition in virtual environment	2,74	

Fig. 12
Pubblications categorized per "eco-design", "gemmology", "innovation" and "promotion" and their sub-categories. Elaboration by the Authors.

A higher percentage is found for studies related to the eco-design category, which covers both aspects related to the extraction of rough stones in the main mining contexts as better described in the previous section, as well as those of conscious design from the design phase to the education phase toward responsible consumption. This is followed by the category gemmology with studies of stones from their theoretical approach, to their demand in the market to contemporary scenarios of lab-grown stones; the category innovation with an in-depth look at the applications of the latest technologies to the gemmological field; and finally the category promotion with experiences of communicating past and contemporary jewelry in a virtual environment [Fig. 13]. These categories confirm the scientific nature of the multiscale approach of the present study on the topic of gemstone design from the atomic to the object scale outlined in the introduction.

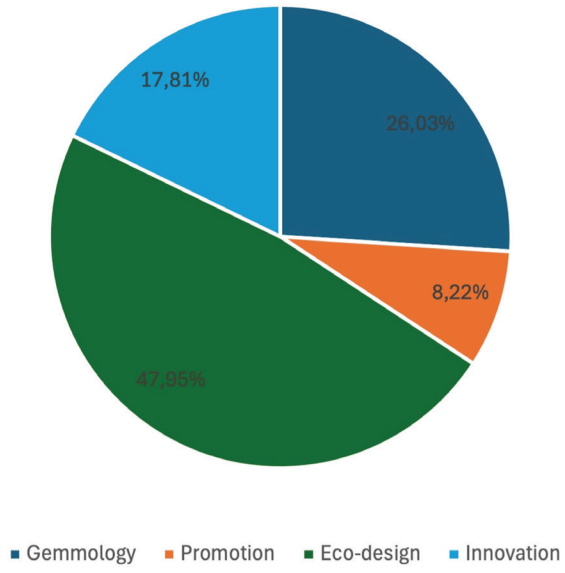

Fig. 13
Percentage of selected articles per categories. Elaboration by the Authors.

Deferring to the conclusion for a more in-depth discussion of the scientific papers related to the specific category "innovation," which is closer to the disciplinary scope of design and therefore of greater interest to this paper, we recall by way of example the most significant publications in the remaining three categories. For the "eco-design" category, papers 11 (Serdari, 2017) and 51 (Mallampalli, 2022) introduce ergonomic studies to improve the technical characteristics of gem processing machines and thus the performance in terms of

production in an eco-oriented way; for the "gemmology" category, publication 55 (Dhaher, 2023) defines an analytical protocol for the evaluation and selection of high-quality gemstones; for the "promotion" category, noteworthy is article 33 (Balzani, 2024), which proposes strategies for extended fruition in a virtual environment of heritage including some gemstones. Therefore, in line with the areas of interest and contributions of the articles, the qualitative analysis will continue with the retrieval and content analysis of the full papers and will cover future developments of this study.

4. CONCLUSIONS

Reading the outcomes of the literature review according to a content-specific focus on the discipline of design revealed interesting declinations of the theme in the category of "innovation". Significant experimentation is noted in the areas of 3D modeling and 3D printing for analysis and design with applications also in fields other than gemology, as well as in the application of the most advanced AI technologies for the formulation of predictive scenarios and block-chain for the evaluation, traceability and security of valuables.
While in absolute terms the specific category "innovation" has shown a growing interest of the scientific community in the developments and results obtained thanks to digital technologies in the gemmological field, it is in percentage terms less widespread in the scientific literature compared to the categories "eco-design" and "gemmology".
The achievement of the objective of the present research emerged from the literature review, which highlighted the advantages in terms of sustainability of digital modeling at all stages and in different possible applications. In this sense, the outcomes arrived at by the following publications are particularly significant and illustrative of the experiments from the atomic to the object scale that are still ongoing in the scientific landscape. Publication 3 (Zheng, 2025) proposes a method for optimizing circular matrix cuts of gemstones through mathematical and geometric models based on parameters that can improve brightness, uniformity, and scintillation. On the other hand, paper 14 (Zhu, 2023) presents resource optimization in the field of jewelry design and processing of synthetic stones through a protocol that defines the operational process from the 3D model construction stage to its prototyping. Scientific paper 39 (Rifai, 2021) extends the applications of 3D printing to the medical field specifically to additive manufacturing techniques for the fabrication of diamonds in the orthopedic field. Finally, publication 6 (Lyu, 2024) applies generative AI in the field of jewelry design through an experimental study also based on industry questionnaires; while publication 22 (Alnuaimi, 2022) proposes the use of block-chain for digital certification and sale history of gemstones.
This result encourages the authors in pursuing this line of research by directing future developments also to multidisciplinary experiments of the topic, enabling to move with greater awareness in current investigative scenarios.

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