Materiality in Architecture: Exploring the Relationship of Belief, Knowledge, Practice, and Visual Perception of Ecological Materials

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Abstract. This study synthesizes how belief, knowledge, and practice jointly shape the visual perception of ecological materials within the context of architectural materiality. Based on a review of 51 publications from psychology, anthropology, education, and material studies, the findings show that prior research has tended to examine these three dimensions separately or only partially, leaving no comprehensive explanation of how they interact. This study fills that gap by identifying the subdimensions and operational aspects of belief, knowledge, practice, and the visual perception of ecological materials, while synthesizing how these dimensions work together in forming visual perception. The findings demonstrate that visual perception is not a direct response to physical appearance but the result of a mediated interpretive system: belief provides the initial meaning frame, knowledge refines and corrects that belief-based impression, and practice sharpens visual sensitivity through repeated experience. Beyond mediation, feedback mechanisms show that visual perception subsequently reshapes belief, knowledge, and practice, producing ecological interpretations that continually evolve both culturally and cognitively. The resulting thematic mapping provides a comprehensive conceptual foundation for developing research instruments in the follow-up study titled "Materiality in Architecture: The Relationship of Belief, Knowledge, and Practice to the Visual Perception of Ecological Materials," including survey design, perception measurement tools, and quantitative modeling for empirical validation.

Keywords: Belief, Knowledge, Materiality, Practice, Visual perception of Ecological Material.

1 Introduction

One of the central challenges of contemporary architecture in the Global South is the increasing homogenization of design forms and practices, which often overlooks the richness of local contexts, material traditions, and community spatial experiences. This phenomenon is shaped by globalization pressures, international industry standards, and the dominance of Global North theories that tend to treat materials as purely technical components. In this regard, materiality is understood not as a matter of construction efficiency or sustainability compliance, but as a cultural condition shaped by

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worldviews, environments, and lived practices, including the ways communities generate knowledge from situated experience. Materiality emerges from how societies assign meaning and value to materials through beliefs, knowledge, and everyday practices, producing contextually rooted understandings shaped by cultural, ecological, and historical conditions. These locally formed understandings guide how materials are interpreted, evaluated, and used, whether through traditions, symbolic associations, or ritual functions. Accordingly, this study adopts a perspective that views materiality as culturally embedded and contextually grounded, aligned with concerns for cultural resilience and diverse material ecologies in the Global South.

When materials play a major role in architectural practice, the interaction between humans and materials typically involves perception [1]. Material perception is not limited to evaluations of physical properties, but also connects these materials to more abstract meanings that form once the senses respond to their initial stimuli [2]. Understanding material perception is therefore essential for optimizing user experience [1], [2]. In line with this, the present study proposes a conceptual relationship linking materiality to the intertwined dimensions of belief, knowledge, and practice, and examines how these internal dimensions shape architects' visual perceptions of ecological materials.

In sustainable architecture, the use of ecological materials has gained increasing attention, making it crucial to integrate visual perception with ecological material use [3], [4], [5]. Without an understanding of visual perception, ecological considerations alone may lead to design failures in accommodating user experience [5]. Because architects serve as key decision makers, understanding how they perceive ecological materials through the framework of belief, knowledge, and practice becomes essential for determining the acceptance, adaptation, and contextual integration of sustainable materials [3], [5], [6], [7]. By emphasizing cultural, symbolic, and experiential layers inherent in material choice, this study contributes to broader debates on cultural resilience and situated knowledge in Global South contexts.

To strengthen this contextual foundation, the literature informing the conceptual relationship was deliberately selected from sources that situate materiality within specific cultural, geographic, and historical environments. Rather than relying on universalized or placeless theory, the 51 reviewed publications represent diverse locations across Western countries, Asia, Africa, the Middle East, and Latin America, where material practices are shaped by local cosmologies, ritual systems, ecological adaptation, and sociohistorical trajectories. For example, studies on belief derive from contextually grounded settings such as ancient Greek ritual cultures [8], China / East Asian cultural transmission [9], Catholic and Islamic belief structures [10], and East European identity formation [11]. Tradition and symbolism are likewise culturally anchored, as seen in North American domestic symbolism, social identity in European contexts [12], and cross generational value internalization in varied cultural settings [13].

Similarly, literature on knowledge demonstrates how knowledge is shaped by place, identity, and situated histories, including domain specific knowledge in Western educational systems [14], [15], [16], socioculturally shaped epistemic cognition [17], discursive knowledge production in Europe [18], and reflective meaning making in Lithuania [19]. Literature on practice highlights culturally situated spatial practices, from

Indigenous taskscapes [20], to material practices in Mediterranean and North American archaeological contexts [21], and socially embedded assemblages [22]. Research on visual perception also reflects culturally specific material ecologies, such as European wood cultures [23], Asian perspectives on sustainable appearance [5], [6], bio based materials in global production settings [24], and cross cultural material preferences in Germany and Scandinavia [25].

Although prior studies across psychology, anthropology, education, and material culture have examined belief, knowledge, and practice, existing research tends to address these dimensions separately or only partially, leaving no comprehensive understanding of their interrelation. Some studies focus solely on belief, such as research on religious meaning, symbolic interpretation, and cultural memory [8], [26], [27], or psychological work that highlights belief as the basis for attitude formation [28], [29]. Studies on knowledge typically conceptualize it as cognitive structure, domain-specific understanding, or epistemic belief [14], [15], [17], [30]. Meanwhile, research addressing practice focuses on material engagement and embodied making without linking it to belief or knowledge, as seen in anthropological and architectural accounts of practice, agency, and material interaction [31], [32].

A smaller body of work links two dimensions. For example, connections between belief and knowledge are explored in epistemic cognition research, where epistemic beliefs shape knowledge evaluation [15], [17]. Studies that link knowledge and practice appear in the material engagement literature, where knowing emerges through skilled interaction with material environments [31], [33]. Likewise, research connecting belief and visual perception demonstrates how moral or ideational beliefs influence interpretations of naturalness and sustainability in ecological materials [24], [34], [35].

However, very few works address all three dimensions simultaneously, and even those that do tend to treat them implicitly rather than through explicit theoretical integration, such as studies on cultural meaning-making in material perception [23], or practice-based interpretations of ecological materials [24], [36]. Thus, despite scattered connections, there remains a clear opportunity to synthesise belief, knowledge, and practice comprehensively as an integrated conceptual foundation for understanding materiality in architecture, particularly in relation to the visual perception of ecological materials.

This study addresses that gap by (1) identifying the constituent aspects of belief, knowledge, practice, and visual perception of ecological materials, and (2) synthesizing how belief, knowledge, and practice interact to shape perceptual interpretation within architectural materiality. Although the study does not collect empirical data, it systematically integrates existing scholarship to establish a comprehensive conceptual foundation for future empirical research. Through this synthesis, the study positions materiality as a culturally grounded, epistemically structured, and practice-embedded dimension of architecture, an understanding that is essential for advancing sustainable design discourse, particularly in the Global South.

2 Development of the Concept of Materiality in Architecture

The concept of materiality in architecture has evolved from an early focus on physical and performative material properties toward increasingly complex, multidimensional, and relational understandings. Initially, materiality referred to inherent qualities explored through direct experimentation, but over time the concept expanded to include the symbolic, cultural, experiential, and relational dimensions shaped by belief, knowledge, practice, and human–material interactions. This historical shift provides the foundation for mapping the development of materiality across five major stages.

Materiality as Physical and Inherent Properties. Early architectural discourse emphasized the physical characteristics of materials, such as density, porosity, roughness, flexibility, and opacity, revealed through direct, hands-on operations including cutting, folding, tearing, weaving, laminating, and gluing [37]. Materiality was framed as something that emerges from empirical interaction, highlighting basic performativity without broader symbolic or cultural layers. The focus lay in understanding materials as technical foundations for design.

Materiality as Sensory, Symbolic, and Cultural Meaning). In the early 2000s, materiality expanded into experiential and meaning-making processes. Materials convey sensory, emotional, social, and symbolic meanings, influencing how users interpret artifacts and spaces [38]. Schropfer (2012) situated materiality within an evolving cultural landscape, noting that materials may carry ideological (e.g., sustainability), temporal, economic, or performative meanings [39]. Materiality thus became dynamic, constructed through interactions among users, cultural contexts, and exploratory design practices.

Materiality as Innovation and Research Systems. A further shift positioned materiality within ecosystems of design research and innovation. Initiatives such as the Harvard GSD Materials Collection [37], [39] demonstrated how recontextualizing materials beyond conventional uses opens new design potentials. This stage emphasized techno-cultural feedback loops, where new materials such as ETFE, composites, and aerogels transform aesthetics, construction techniques, and architectural paradigms. Materiality here is a driver of innovation shaping form and experience.

Materiality in Digital Artifacts. With digital technologies, materiality expanded into hybrid physical–digital domains. Jung & Stolterman (2011) introduced digital materiality, describing computation as a “material without qualities,” rich in potential yet lacking the sensory depth of physical matter [38]. Designers increasingly sought to embed tactile, expressive, or interactive qualities into digital devices through imitation, gesture- based interaction, or haptic augmentation. Materiality thus spanned physical substance and digital affect, situated between devices, bodies, and sensory expectations.

Materiality as Human–Material–Spatial Relations. Recent discourse on embraces a relational paradigm. Loschke (2016) and Picon (2020) argue that materiality is produced through interactions among humans, materials, perception, light, and space [1], [40]. Materials become active agents shaping visual, atmospheric, and spatial experience. Picon (2020) further situates materiality within the domains of belief, knowledge, and practice, explaining how people understand and assign meaning within relational ecosystems [1]. Materiality is therefore understood not as a static property, but as a living process embedded in contemporary material culture and human–environment relations.

3 Materials and methods

This study employs an integrative literature review, an interdisciplinary method that synthesizes concepts from journals, books, professional standards, and institutional reports. This approach is suitable for a conceptual and exploratory study that does not gather empirical data but aims to develop a framework connecting belief, knowledge, practice, and the visual perception of ecological materials within architectural materiality. Although the literature sources are global, the analysis is anchored in Global South contexts, where material traditions, cultural meanings, and ecological adaptation shape how materials are perceived. Accordingly, the integrative review is used not to produce universal generalizations, but to build a conceptual foundation for future empirical validation in specific regional settings.

3.1 Databases and Search Terms

The literature search process was conducted through various scientific sources, including academic databases such as Scopus, Google Scholar, and other academic repositories relevant to the fields of architecture, design, material cognition, and visual perception. The search strategy used two groups of keywords designed to capture the scope of the concepts of materiality and visual perception of ecological materials. The first group focused on the dimensions of materiality and the internal aspects of designers, using a combination of keywords: "materiality in architecture" AND (belief OR knowledge OR practice), which yielded 676 publications. The second group focuses on the visual perception of ecological materials with the keywords: "visual perception" AND "ecological materials", which yielded 86 publications. Overall, the initial identification process yielded 762 publications, which were then further filtered based on inclusion-exclusion criteria. After completing the search process in both databases, a total of 762 articles were retrieved, as shown in Table 1.

Table 1. Search strings from Scopus and WoS to identify relevant articles

Search terms	Number of articles retrieved
"materiality in architecture" AND (belief OR knowledge OR practice)	676

"visual perception" AND "ecological materials"	86
Total	762

3.2 Inclusion and Exclusion Criteria

Literature selection was conducted using a series of inclusion criteria to ensure that the publications analyzed were directly relevant to the research objectives. Inclusion criteria included: (1) publication type, such as journal articles, academic books, conference proceedings, research reports, and professional standards; (2) topic relevance to materiality in architecture, belief, knowledge, practice, or visual perception of ecological materials; (3) strong relevance to the context of architecture and design, especially linking ecological materials to visual perception; (4) publication period between 2000–2024, in line with contemporary developments in materiality and sustainability studies; (5) use of English; (6) academic quality that can be accounted for through peer review or originating from credible scientific institutions; and (7) provision of data, abstracts, or methods that enable conceptual analysis.

Conversely, publications are excluded if: (1) they do not discuss materiality or the visual perception of materials; (2) they have no explicit connection to the dimensions of belief, knowledge, or practice; (3) they do not provide full-text access; or (4) they are editorials, popular opinions, or non-academic material. The application of these criteria ensures that the remaining literature is truly relevant and of sufficient quality for in-depth analysis

3.3 Article Selection Process

The article selection process followed PRISMA guidelines. From an initial 762 publications identified, 29 duplicates were removed. During screening, 733 records were evaluated based on title, abstract, publication year, language, document type, and status, resulting in the exclusion of 393 items. Of the 340 remaining records, 231 were removed for irrelevance after keyword checks. In the eligibility stage, 109 full-text articles were assessed, and 56 were excluded because they were unrelated to building materials (n=11), did not discuss visual perception (n=23), were review papers (n=14), or lacked full-text access (n=10). Ultimately, 51 articles met all criteria and were included in the final analysis.

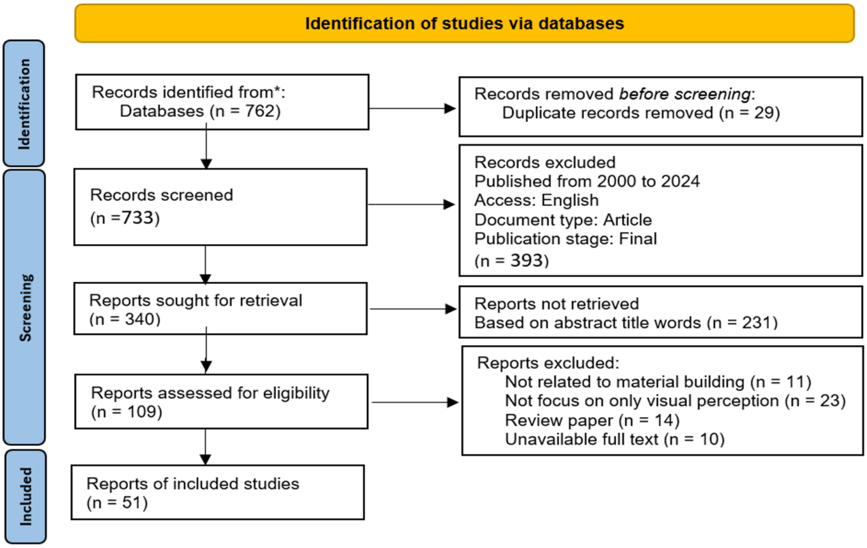

Fig. 1. PRISMA flow diagram of the article selection process

3.4 Analysis and Synthesis Methods

The literature was analyzed using systematic thematic coding to identify key conceptual structures. Four themes, belief, knowledge, practice, and visual perception of ecological materials, served as the analytical framework. The interpretation was guided by a Global South perspective, considering local material traditions and spatial, ecological contexts. The results are presented in tables of indicators and subdimensions, along with diagrams illustrating how the three internal dimensions shape visual perceptions of ecological materials. This contextually grounded approach strengthens the framework and prepares it for future empirical testing.

4 Results

A comprehensive qualitative assessment of relevant literature was conducted to address the research objectives. All selected articles and documents were thoroughly reviewed and coded using a thematic approach. The coding process began with the establishment of initial themes based on Picon's theoretical framework, namely the three main dimensions of belief, knowledge, and practice, which are considered the basic conceptual framework for understanding materiality in the context of architecture. Because the focus of the study also included visual responses to ecological materials, the research team added a fourth theme, visual perception of ecological materials, as an a priori theme that was conceptually and empirically relevant.

4.1 The aspects that constitute belief

Belief is a cognitive, affective, and social construct that shapes how individuals and groups interpret the world, assign meaning, and guide action, understood psychologically as a conviction that forms the basis for evaluation and attitudes [28] and operating within identity-linked systems of belief [11]. Belief is expressed through religious teachings, cultural practices, symbols, and rituals[8], [41], and varies in intensity from strong religious commitments to weaker traditional orientations [26]. Belief also shapes knowledge processes, as epistemic beliefs influence truth judgments and prior beliefs anchor the interpretation of new information [15], [17]. In material practice, belief is reflected in culturally grounded and ritual interactions with objects guided by shared cosmologies [31]. In material perception, moral and ideational beliefs inform judgments of naturalness and sustainability [24], [34], [35]. Accordingly, the literature identifies religion, which provides normative moral orientation, and tradition, which governs inherited social values, as the main subdimensions of belief.

Religion represents a high-intensity form of belief because it involves strong commitment to teachings, rituals, moral values, and meaning structures that shape individuals' social and spiritual lives [8], [26]. This subdimension includes attitude, dogma, and moral prescription. Attitudes function as evaluative predispositions rooted in belief [28] and shaped through experiences and internalized knowledge [29], while religious systems provide frameworks of right and wrong [8], [26], reinforced by inherited communal values transmitted across generations and internalized as part of religious meaning structures [26]. Dogma consists of core binding teachings, such as ideas of salvation, life's meaning, and divine justice, that form the normative basis for belief and behavior [8], [26]. Moral prescriptions, understood as divine moral rules, guide judgments of what is right, just, and valuable in daily life [8], [26]. These moral orientations also shape people's evaluative beliefs when interpreting materials or sustainability-related attributes [34], [35].

Tradition is a lower-intensity belief system rooted in inherited practices, rituals, and values that maintain cultural continuity and shape social expectations across generations, functioning as a cultural memory structure that preserves shared meaning, moral orientations, and collective identity [27]. It is expressed through symbols and embodied practices that serve as carriers of cultural memory, linking individuals to broader value systems and to familial or communal heritage [27]. Tradition also shapes hope by transmitting long-term expectations regarding moral continuity and future-oriented values [26], [42], and contributes to identity formation by embedding individuals within cultural categories and social group membership [43] that develop through sustained internalization of shared norms [13]. As shown in empirical work on material perception, such inherited symbolic associations influence how naturalness, authenticity, and ecological qualities are visually interpreted [23], [24], [34], demonstrating how tradition-based beliefs continue to shape material judgments.

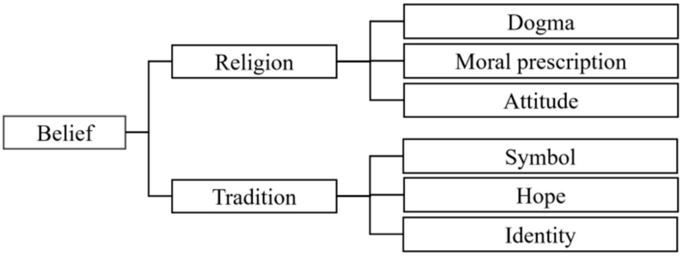

Fig. 2. Subdimensions and aspects of belief

4.2 The aspects that constitute knowledge

Knowledge. Contemporary understandings of knowledge have advanced across disciplines over the past two decades. Ackerman (2000) identifies domain-specific knowledge as the "dark matter" supporting adult cognition [14], while Star (2005) emphasizes procedural knowledge as flexible rather than mechanistic [44]. Baroody, Feil, and Johnson (2007) reconceptualize knowledge as the dynamic integration of conceptual and procedural forms [44]. Broader views describe knowledge as a construction of information, beliefs, skills, and experiences [45], aligning with Greene et al. (2016) [17]. Applied perspectives expand these views by defining knowledge as a dynamic justification for action [33], reflective meaning-making [19], and discursive production shaped by interpretive practices [18], synthesized comprehensively through the multidimensional framework proposed by McCarthy and McNamara (2021) [30]. Knowledge is therefore complex and dynamic, structured by four key subdimensions, amount, accuracy, specificity, and coherence, that collectively shape understanding.

Amount refers to the number of relevant concepts in memory that support comprehension. It includes breadth of concepts, or the range and diversity of ideas a person possesses [16], [46], knowledge activation, or the ability to retrieve concepts needed for inference-making [47], [48], and domain assessment, which evaluates the breadth of knowledge in a particular field. Prior knowledge also governs the activation of meaning in material contexts, such as consumers' knowledge of material origins shaping judgments of naturalness [23] and users' sustainability knowledge influencing visual assessments [36].

Accuracy concerns the correctness of knowledge stored in memory and its freedom from conceptual errors that hinder comprehension. It includes conceptual correctness, or the absence of misconceptions that obstruct integration of new information [49], misinformation, reflecting vulnerability to inaccurate external input [50], [51],and knowledge updating, or the ability to revise inaccurate beliefs by integrating more accurate information [52]. Because beliefs often anchor meaning-making, accuracy is shaped by social and identity-based knowledge structures [13], [43].

Specificity refers to how closely a reader's or practitioner's knowledge aligns with the domain, subject, or context of a task. It includes domain relevance, or general field knowledge supporting broad comprehension [15], topic-specific knowledge, which facilitates activation of concepts directly related to the text [53], and task appropriateness, or the degree to which knowledge is suited to situational demands [54], [55]. In material contexts, specificity is reflected in user knowledge of bio-based materials [24] and ideational or moral knowledge that informs evaluations of naturalness and sustainability [34], [35].

Coherence refers to the degree of internal connectedness within a person's knowledge, forming an organized structure that supports comprehension. It includes concept interconnectedness, or strong and dense relations among concepts that ease activation and inference-making [56], [57], and knowledge organization, or the structured integration of concepts enabling the combination of old and new information [48], [52]. Coherence is further strengthened through embodied, practice-based knowledge, as demonstrated in material engagement theories where knowing emerges through iterative, skilled interaction with materials [20].

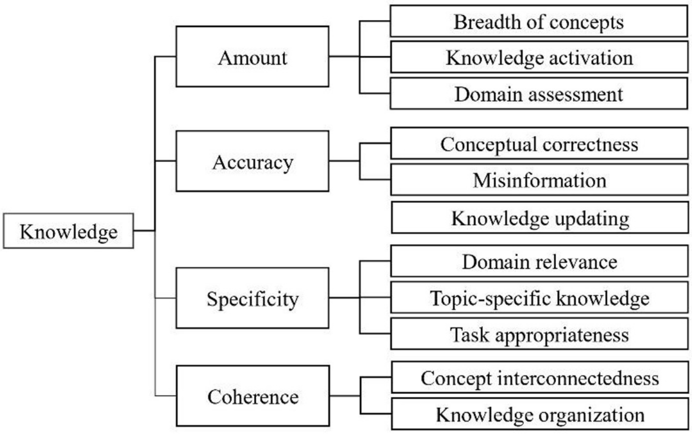

Fig. 3. Subdimensions and aspects of knowledge

4.3 The aspects that constitute practice

Practice in architecture is understood as a dynamic process that continually "unfolds in time" [32], shaped by ongoing actions and decisions that respond to shifting project conditions and material realities. This aligns with Ingold's (2013) view of practice as making, an open, relational flow between humans, materials, and the environment, making it inherently adaptive, experimental, and responsive [20]. Shared cultural and ritual actions also demonstrate that practice is embedded in lived material engagements, as seen in anthropological accounts of material rituals and symbolic enactments [8]. Van Dyke (2015) further describes practice as repeated interaction between human agents and objects that produces social and material transformation [21], while DeLanda (2016) frames it as part of an assemblage requiring constant tactical adjustment to changing conditions [22]. Synthesizing these views, practice emerges as an adaptive and performative operational process, enacted through direct engagement with materials and space, and consisting of two core subdimensions: agency and action [32].

Agency refers to the capacity of humans and architecture to create change through conscious and strategic action [32]. It arises from repeated interactions among humans, objects, and spatial contexts that generate material and social consequences [21], unfolding through improvisational responses to environmental dynamics [31]. Agency includes two key aspects: ability to act, which reflects practitioners' capacity to initiate and direct concrete actions, and tactical improvisation, the creative and adaptive response to uncertainty that evolves directly from field conditions [21], [31], [32]. Agency also involves identity, shaped by accumulated cultural, professional, and experiential knowledge [19], [30], [33], which influences how practitioners perceive situations, negotiate constraints, and enact decisions in practice.

Action encompasses operational acts carried out in response to project needs and situational constraints, characterized by their dynamic and non-repetitive nature [32]. In line with Ingold (2022) and DeLanda (2016), action is part of the making and assemblage process that requires continuous adaptation to material and contextual conditions [22], [31]. It consists of three main aspects: experimentation, involving creative exploration, iteration, and spontaneous responses to uncertainty (Allen, 2009; Ingold, 2013; Van Dyke, 2015); tactical adjustments, referring to real-time adaptive decisions made to maintain project stability amid regulatory, budgetary, and on-site pressures [22], [31], [32]; and operations, which include direct material interventions such as construction and manipulation that transform spatial and material relationships [21], [22], [32]. These forms of action are reflected not only in architectural work but also in material engagement studies, where users' interactions with ecological materials, such as wood treatment, biodegradation, construction performance, or surface evaluation, illustrate how perception is shaped through hands-on practice [23], [24], [25], [36]. Together, these aspects demonstrate that action forms the operational backbone of architectural practice, shaping its continuity and evolution.

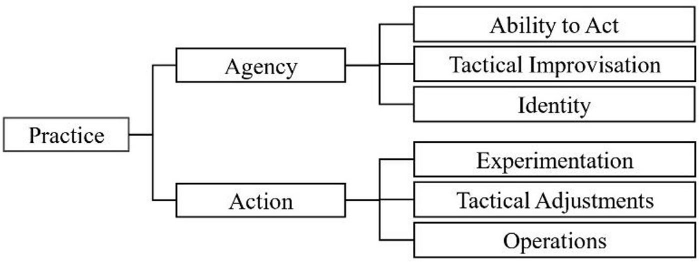

Fig. 4. Subdimensions and aspects of practice

4.4 The aspects that constitute visual perception of ecological materials

Visual perception of ecological materials refers to how users, designers, and decision makers evaluate the ecological quality of materials based on observable visual characteristics. This aspect consists of six sub-aspects: perception of naturalness, perception of sustainability, aesthetic perception, perception of bio/green, and consumer preference. Literature identifies six indicators, naturalness, sustainability, environmental friendliness, aesthetics, bio attributes, and user preferences, that explain how material appearance is interpreted in relation to nature, environmental impact, sustainability, aesthetic value, bio-based qualities, and evaluative responses [6], [23], [34]. Broader scholarship also demonstrates that multi-sensory perceptual mechanisms [9], perception-in-action during material engagement [20] and visual-material assessments embedded in practice [21].

Perception of naturalness consists of two sub-aspects: textures mimic nature and minimally processed. Textures mimic nature refers to materials that visually imitate natural elements through texture, color, and fiber patterns resembling their original forms [6], [23]. Minimally processed materials remain close to their raw state because they undergo limited manufacturing intervention, which increases perceived naturalness [34]. Naturalness intensifies when materials present organic cues, such as solid wood, stone, or OSB with pronounced fibers [6], [23]. The importance of visual cues in identifying naturalness aligns with broader theories of perceptual interpretation shaped by sensory processing [9] and perception-in-action [31].

Perception of sustainability is interpreted visually through three sub-aspects: user appeal, functionality, and resource efficiency [36]. User appeal emerges when rough textures, muted or matte colors, or speckled recycled plastics visually communicate sustainable qualities [58], consistent with hedonic responses in perceptual experience [59]. Functionality concerns visually inferred performance, safety, or durability [34]. Resource efficiency refers to visual interpretations associated with reduced resource use or environmentally responsible production [60], linked to innovation-driven material strategies [61].

Aesthetic perception refers to the way users visually evaluate the beauty, harmony, and expressive qualities of materials based on formal, sensory, and symbolic cues, reflecting both perceptual mechanisms [9] and visual meaning-making grounded in material appearance [6], [23]. This subdimension consists of four sub-aspects, maximum effect through minimal means, unity in variety, MAYA (most advanced, yet acceptable), and optimal fit [62]. Maximum effect through minimal means refers to the strong visual impact achieved through simple formal expression, unity in variety describes visual coherence through balanced variation, MAYA captures the balance between novelty and familiarity, and optimal fit reflects harmony among form, function, and context [62].

Perception of bio/green refers to how users visually infer the ecological and biological qualities of materials based on cues related to natural origin, renewable content, or biodegradability, as demonstrated in studies of biocomposites and bio-based materials [24]. This subdimension consists of three sub-aspects, biocomposite materials, bio-based materials, and biodegradability [24]. Biocomposite materials involve fiber-reinforced or plant-based composites, bio-based materials include biopolymers such as starch, lignin, or natural rubber, and biodegradability refers to the visual inference that a material can decompose safely. These perceptual judgments are reinforced by embodied visual–material assessment during material interaction [21], [31].

Consumer preference refers to how users form evaluative choices about materials based on visual cues that align aesthetic, functional, and moral expectations with perceived qualities, reflecting culturally mediated perceptual and experiential frameworks [9], [23]. This subdimension consists of two sub-aspects, instrumental and ideational

[34]. Instrumental preferences arise when visual characteristics suggest functional benefits such as durability, safety, or ecological performance, while ideational preferences emerge from moral, symbolic, or aesthetic associations that make natural materials feel more ethically or visually appropriate [34]. Visual preferences are also shaped through accumulated experience and direct interaction with material surfaces [25], [63].

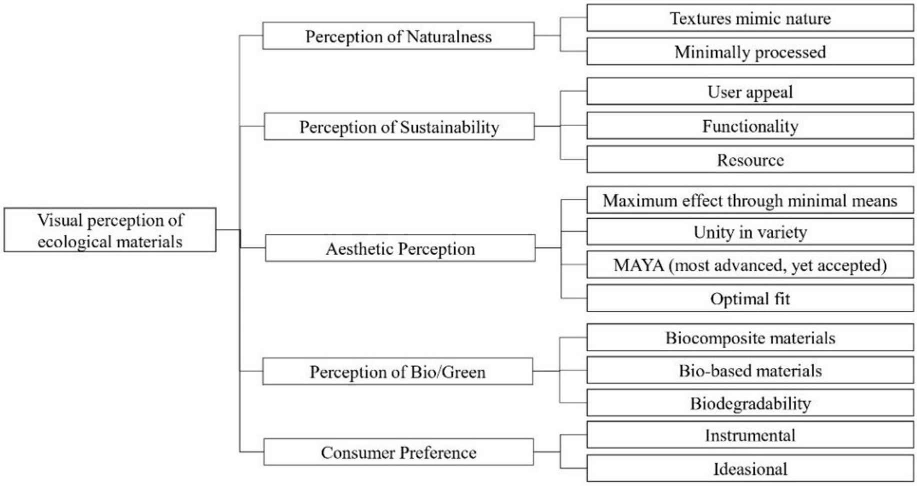

Fig. 5. Subdimensions and aspects of visual perception of ecological material

Despite extensive prior scholarship, studies on belief, knowledge, and practice have treated these dimensions separately or only partially, leaving no comprehensive understanding of how they jointly shape materiality, especially the visual perception of ecological materials. To clarify this landscape and highlight the conceptual gaps, Table 2 presents a condensed mapping of the reviewed sources, showing which dimensions each study explicitly addresses. This summary underscores the need for an integrated conceptual foundation, reinforcing the contribution of the present study in synthesizing belief, knowledge, and practice within a unified framework of architectural materiality.

Table 2. Mapping of Dimensions Addressed in Prior Studies

No	Year	Source	Belief	Knowledge	Practice	Visual Perception	Very Brief Summary
1	2000	Bodur et al.	✓	–	–	–	Belief→attitude
2	2000	Ackerman	–	✓	–	–	Domain knowledge
3	2002	Marsh et al.	–	✓	–	–	Misinformation
4	2003	Gawronski	✓	–	–	–	Belief-attitude
5	2003	Carlson et al.	–	✓	–	–	Knowledge organization
6	2003	Ljungberg	–	–	–	✓	Functionality perception
7	2003	Hassenzahl	–	–	–	✓	User appeal

8	2004	McNamara & McDaniel	–	✓	–	–	Knowledge breadth
9	2005	Star	–	✓	–	–	Procedural knowledge
10	2005	Maiello	✓	–	–	–	Belief intensity
11	2006	Hekkert	–	–	–	✓	Aesthetic model
12	2007	Baroody et al.	–	✓	–	–	Knowledge integration
13	2007	Snyder	✓	–	–	–	Hope & belief
14	2007	Ozuru et al.	–	✓	–	–	Topic knowledge
15	2007	Chrysso-choou	✓	–	–	–	Identity
16	2007	Kendeou & O’Brien	–	✓	–	–	Updating
17	2009	McNamara & Magliano	–	✓	–	–	Coherence
18	2009	Allen	–	–	✓	–	Agency/action
19	2010	Høibo	–	–	–	✓	Wood preference
20	2011	Ingold	✓	–	✓	✓	Making & perception
21	2011	Assmann	✓	–	–	–	Cultural memory
22	2012	Greene et al.	✓	✓	–	–	Epistemic belief
23	2012	Murphy et al.	–	✓	–	–	Knowledge definition
24	2012	Li & Chapman	✓	✓	–	✓	Sustainability eval
25	2013	Ingold	✓	–	✓	✓	Perception-in-action
26	2013	Florez et al.	–	✓	–	✓	Sustainability cues
27	2014	Reed et al.	✓	✓	–	–	Identity norms
28	2015	Harrison	✓	–	✓	–	Ritual/material
29	2015	Burnard et al.	✓	–	✓	✓	Naturalness jury
30	2015	Manuel	–	–	–	✓	Material preference
31	2015	Van Dyke	✓	–	✓	✓	Practice perception
32	2016	Magnier et al.	✓	✓	–	✓	Eco-perception
33	2016	Buehl et al.	✓	✓	–	–	Epistemic belief
34	2016	Du Bois et al.	–	–	–	✓	Sustainable appeal
35	2017	Kolb & Kolb	–	–	–	✓	Experiential perception
36	2017	Burnard et al.	✓	✓	–	✓	Material knowledge
37	2017	Vosniadou & Skopeliti	–	✓	–	–	Misconceptions
38	2018	Gao	–	✓	✓	–	Knowledge→action

39	2019	Kendeou et al.	–	✓	–	–	Revision
40	2019	O'Reilly et al.	–	✓	–	–	Task knowledge
41	2019	McCarthy et al.	–	✓	–	–	Task alignment
42	2021	Indrašienė et al.	✓	✓	–	–	Belief-identity
43	2021	McCarthy & McNamara	–	✓	–	–	Knowledge framework
44	2022	Brandt	✓	–	–	–	Belief identity
45	2022	Manu et al.	✓	✓	✓	✓	Bio-material perception
46	2022	Maciag	–	✓	–	–	Discursive knowledge
47	2022	Chen	–	–	–	✓	Sensory perception
48	2023	Zhang et al.	–	–	–	✓	Naturalness/aesthetic
49	2003	Žižek	✓	–	–	–	Belief ideology
50	2013	Manning	✓	–	✓	✓	Material engagement
51	2014	McCarthy	–	✓	–	–	Knowledge processing

5 Discussion

5.1 Roles of Belief, Knowledge, Practice, and the Visual Perception of Ecological Materials

The findings show that the visual perception of ecological materials is the joint work of belief, knowledge, and practice, each contributing a distinct function in shaping how materials are visually interpreted. Belief provides the initial interpretation by assigning symbolic, cultural, and moral meanings to material appearance. This is consistent with Harrison (2015) [8] and Assmann (2011) [27], who demonstrate how cultural beliefs and collective memory form interpretive categories such as "natural," "authentic," or "pure." However, the findings also challenge belief-dominant perspectives such as Maiello (2005), showing that belief-based impressions are never final [26].

Knowledge corrects and refines early belief-based interpretations by offering a cognitive basis for judging whether a visual cue truly represents ecological performance. This aligns with epistemic cognition research [15], [17] and studies on ecological materials [23], [36]. The findings extend these studies by showing that knowledge systematically mediates and reduces interpretive biases, challenging technical-deterministic views that assume ecological qualities are self-evident from physical performance alone.

Practice sharpens visual sensitivity through repeated exposure to materials in design, construction, and everyday settings. This supports material engagement theory [21],

[31] and empirical work showing that experience improves recognition of ecological cues such as fiber density, surface variation, and natural coloration [25], [63]. The findings contrast with digital materiality perspectives [64], which suggest that perception can develop without physical experience, demonstrating instead that visual familiarity remains essential in ecological-material contexts.

Together, the five subdimensions of visual perception, naturalness, sustainability, aesthetics, bio/green perception, and consumer preference, emerge not from physical features alone but from the combined functioning of belief, knowledge, and practice.

5.2 The relationship between belief, knowledge, and practice shapes the visual perception of ecological materials

The findings show that the visual perception of ecological materials is the result of the joint work of belief, knowledge, and practice, not merely a response to what is physically seen. These three dimensions operate simultaneously through mediation and feedback loops, forming an interpretive system in which each dimension continually influences the others. This finding differs from previous studies that connected only two dimensions at a time, such as belief–knowledge [15], [17], knowledge–practice[21], [31], or belief–perception [34], [35], which implicitly assumed that these relationships were partial and not mutually mediating. This study shifts earlier perspectives by demonstrating that visual perception emerges from the integrated interaction of all three dimensions, rather than from a single dominant dimension as suggested in belief-dominant approaches [26].

Within the mediation mechanism, belief provides the initial interpretation of the visual appearance of ecological materials, but this initial interpretation is corrected and refined by knowledge as new information is acquired, as demonstrated by Li & Chapman (2012) and Magnier et al. (2016) [34], [35]. This finding aligns with the epistemic cognition literature [15], [17], which shows that knowledge can revise initial belief-based judgments. At the same time, practice sharpens visual sensitivity through repeated experience, extending material engagement theory [21], [31] by showing that visual familiarity alone can build perceptual sensitivity to ecological cues without requiring tactile interaction.

Within the feedback-loop mechanism, established visual perceptions subsequently influence belief, knowledge, and practice. This finding is consistent with circular meaning-making theory [27], as well as Burnard et al. (2017) which show that repeated visual exposure strengthens beliefs, expands knowledge, and shapes new habits or practices [23]. Thus, what individuals perceive visually is not only shaped by belief, knowledge, and practice, but also reshapes them in return, creating an interpretive cycle that continually evolves.

Overall, this study demonstrates that the visual perception of ecological materials does not emerge from any single dimension, but from the simultaneous and mutually mediating interaction of belief, knowledge, and practice, consistent with the conclusion that what we see shapes our beliefs, expands our knowledge, and transforms our material practices in design.

5.3 Research Contribution, Limitations, and Future Directions

This study contributes theoretically and methodologically by synthesizing the relationship between belief, knowledge, practice, and the visual perception of ecological materials, and by identifying subdimensions and operational aspects that will serve as the foundation for developing research instruments in the follow-up study titled “Materiality in Architecture: The Relationship of Belief, Knowledge, and Practice to the Visual Perception of Ecological Materials.” The thematic mapping produced provides a strong operational basis for constructing questionnaires, perception measures, and SEM or PLS-SEM models. However, because this study is conceptual and relies solely on a systematic literature review, the proposed interrelationships remain exploratory and require empirical validation. Future research should therefore test this model through quantitative or qualitative approaches and adapt it to specific cultural contexts, particularly within the Global South, to capture distinctive material traditions, ecological practices, and visually shaped perceptual dynamics influenced by the sociocultural conditions of these regions.

6 Conclusion

The synthesis of the literature answers the First Research Question by identifying that belief consists of two subdimensions: religion, which includes the aspects of attitude, dogma, and moral prescriptions, and tradition, which includes the aspects of symbols, hope, and identity. The knowledge dimension is composed of four subdimensions: amount (breadth of concepts, domain assessment), accuracy (conceptual correctness, misinformation, knowledge updating), specificity (domain relevance, topic-specific knowledge, task appropriateness), and coherence (concept interconnectedness, knowledge organization). The practice dimension includes two subdimensions, namely agency (ability to act, tactical improvisation, identity) and action (experimentation, tactical adjustments, operations). Meanwhile, the visual perception of ecological materials consists of five subdimensions: naturalness (textures mimic nature, minimally processed), sustainability (user appeal, functionality, resource efficiency), aesthetics (maximum effect/minimal means, unity in variety, MAYA, optimal fit), bio/green perception (biocomposites, bio-based materials, biodegradability), and consumer preference (instrumental, ideational).

This mapping of dimensions and subdimensions forms the basis for answering the Second Research Question, as the resulting conceptual structure enables an explanation of how belief, knowledge, and practice, each of which in the Global South is often shaped by cultural values, local knowledge systems, and everyday practices, contribute to shaping the visual perception of ecological materials. By understanding the values and symbols embedded in belief, the knowledge structures that guide evaluation, and the experiential forms embedded in practice, the mechanisms of interaction among these dimensions can be explained systematically and contextually.

These findings answer the Second Research Question by demonstrating that the visual perception of ecological materials emerges through the integrated interaction of belief, knowledge, and practice, and therefore cannot be understood merely as a response to the physical appearance of materials. This interaction operates through mechanisms of mediation and feedback, making visual perception the result of combined values, knowledge, and experience. Unlike previous studies that linked only two dimensions or positioned belief as the dominant factor, this research shows that knowledge and practice hold equally important mediating roles. Belief provides the initial meaning frame that shapes early perceptual judgments, knowledge refines and corrects these interpretations, and practice sharpens visual sensitivity through repeated experience. Once perception is formed, it subsequently influences belief and knowledge, creating an ongoing cycle, a process that reflects how communities in the Global South continually negotiate meaning, knowledge, and practice in the use of ecological materials.

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