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Material-Driven Design Using the Snow Glass Technique in Arctic Product Design

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Abstract

This article examines how a material-driven design approach using the snow glass technique shapes design processes and outcomes within Arctic product design. Focusing on Arctic glass design, the study explores how snow, as a locally available and temporary natural material, can be integrated into multiple stages of glass design and making processes. The research combines student perspectives on Arctic product design, collaborative practice-based experimentation with Arctic glass design, and experienced practitioners' insights concerning the snow glass technique. The findings indicate that snow functions not only as a reference to Arctic environments but also as a processual element influencing material behaviour, form development, and surface qualities. The study identifies the distinctive characteristics of the snow glass technique and contributes to discussions on material-driven and context-sensitive approaches within Arctic glass design practices.

Introduction

A central challenge for the future of Arctic design lies in responding to the region's highly sensitive environment and its rapidly evolving cultural landscapes. Designers working in Arctic contexts must navigate questions of environmental responsibility and cultural sensitivity while developing products that respond meaningfully to local conditions. In this study, material-driven design is understood as an approach in which materials actively shape design outcomes, processes, and learning experiences. Material-driven design, which facilitates designing for material experiences (Karana et al., 2015), offers a tangible way to explore how direct engagement with materials influences design processes and outcomes. Material experimentation plays a central role in concept development, exploring material variations, and translating ideas into concrete design outcomes, suggesting that material-led processes enhance students' creative development (Laamanen et al., 2023, pp. 35–36).

The accelerating ecological and cultural changes in the Arctic highlight the importance of context-sensitive and locally grounded approaches in Arctic design education. According to Huhmarniemi and Jokela (2020), cultural resilience and regional identity are essential for responding to environmental transformations, while Alvelos and Barreto (2022) emphasise the value of locally situated perspectives in design education. Integrating northern conditions, materials, and cultural traditions into design processes can support more contextually meaningful and diverse approaches within Arctic design. In line with this, holistic, community-engaged, and place-specific approaches position designers as future change-makers within ecological, social, and ecocultural contexts (Huhmarniemi et al., 2025). Art and design education can thus contribute to building a sustainable future for the

Arctic (Jokela & Coutts, 2021). Ongoing transformations within the design field further challenge the existing curricula to anticipate future needs, highlighting the importance of developing adaptive and sustainability-oriented design competences (Silver & Ruokamo, 2025). This study contributes to understanding how material-driven design, craft practices, and Arctic-specific design perspectives support context-aware and materially grounded design practices. The study is particularly relevant for scholars and practitioners working within design education and material-driven design in Arctic contexts.

While the study acknowledges discussions within posthumanist and new materialist scholarship (e.g. Barad, 2007; Lummaa & Rojola, 2014), it primarily adopts a situated approach that foregrounds a northern perspective. This emphasis is intentional and responds to critiques of how the North has often been represented through external viewpoints (Ridanpää, 2019), highlighting the need for context-specific and locally grounded understandings. This study therefore emphasises the interconnectedness of place, material, and making within Arctic design, where the theoretical framing enacts this relational and situated approach in line with the study's aims.

This article examines how local context can be integrated into Arctic product design through a material-driven approach, focusing on locally available natural materials. In Arctic contexts, such materials can include lichen, reindeer antler, and snow; however, this study focuses specifically on the use of snow in Arctic glass design processes. Glass is not a locally sourced or traditionally Arctic material; in this study, the Arctic context is instead defined through the integration of locally available natural materials into the glass design process, which is carried out in collaboration with partner institutions.

In this context, glass serves as a medium for exploring how snow, as a locally embedded material, influences form and surface in Arctic glass design, as its properties enable the visualisation of material interactions in distinct ways. This creates an opportunity to investigate how snow, as an ephemeral and context-dependent material, can shape design outcomes. Despite the growing interest in material-driven design, the role of snow in glass design processes remains largely underexplored. This study addresses this research gap by examining how snow can be utilised across different stages of Arctic glass design, from form exploration to direct interaction with hot molten glass. Through this investigation, the *snow glass technique* is identified, referring to multiple ways in which snow participates in shaping glass artefacts.

Research Question and Empirical Material

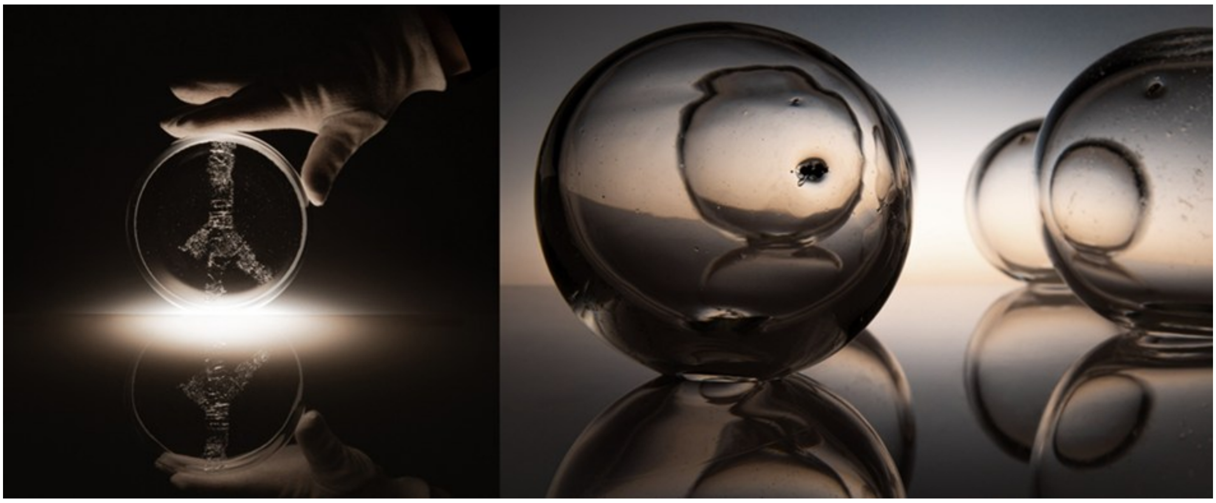
This study adopts a material-driven and practice-based research approach to examine how the use of snow influences the glass design process and its outcomes in an Arctic context. The main research question guiding the study is:

How does a material-driven design approach using the snow glass technique shape design processes and outcomes in Arctic product design?

To address this question, the study draws on three complementary sources of empirical material. *First*, a questionnaire survey explores design students' perceptions of *Arctic product design*. The data provide contextual insight into how design students define the characteristics, distinctions, and future considerations of Arctic product design in general, serving as a contextual framework through which Arctic glass design and the snow glass technique can be situated and interpreted. The *second* dataset examines how the themes identified in the questionnaire, particularly the relationship to nature and the use of northern nature-based materials, are materialised through practice-based experimentation in collaborative *Arctic glass design* student projects. Through these projects, the study investigates how a material-driven design approach shapes processes and outcomes when snow is applied in glass design. *Third*, a practitioner-oriented survey offers additional insights regarding the features, challenges, opportunities, and definition of *snow glass*, a novel glass technique that introduces snow as an active material in the hot glass process (Figure 1).

Figure 1

The snow glass technique enables the creation of unique shapes, patterns, and surface qualities.



Note. On the left, *Peace is Broken*, designed by Milla Johansson, with a pattern created using snow. On the right, *My Land*, designed by student Iiris Orava, where snow was thrown onto the surface of hot glass. Photographs by students Annu Kuivas and Jutta Kotala (2024).

Together, these approaches enable an examination of snow glass as both a technique and a material-driven design approach situated in a specific local context. The study highlights how context-specific materials, such as snow, influence design processes, material experimentation, and design outcomes within Arctic glass design practices.

Context and Material Approaches in Arctic Product Design

This section discusses Arctic product design, Arctic glass design, and the snow glass technique as interconnected context-sensitive and material-driven approaches within Arctic design practices.

Arctic Product Design

The growing awareness of ecological issues within Arctic regions and educational contexts has directed increased attention to Arctic topics, emphasising the sensitivity of northern environments to environmental change (Häkkilä & Johansson, 2018, p. 34). The cultural, environmental, and climatic factors influencing design in the Arctic are discussed in numerous publications (Jokela & Huhmarniemi, 2022; Mäkikalli et al., 2019), but were originally introduced in 2012 (Tahkokallio, 2012). Arctic design can be understood as an approach grounded in the Arctic context, drawing on multiple design disciplines and foregrounding sensitivity to both human and nonhuman well-being (Usenyuk-Kravchuk et al., 2020, pp. 17–20). It focuses on developing products, services, and systems that respond to the specific environmental, cultural, and material conditions of Arctic regions.

Within this context, Arctic product design addresses the region's unique challenges and opportunities by engaging with locally situated knowledge, materials, and practices. Rather than being defined solely through sustainability goals, it involves navigating environmental constraints, cultural meanings, and resource availability in contextually appropriate ways. According to Johansson (2024), *'Arctic product design adjusts contributions to the unique environmental aspects of the Arctic, striving to develop resilient, sustainable, and culturally fitting solutions'*. The key is to grasp the needs, challenges, and opportunities of the Arctic and address them in a manner tailored to the region and its conditions (Miettinen et al., 2014).

The Arctic region is particularly sensitive to climate change, and design approaches often include considerations related to environmental impact, resource use, and material responsibility. Material cultures rooted in Northern knowledge form an important part of Arctic ecocultures and local identity (Huhmarniemi & Jokela, 2020, p. 14). While sustainability is often emphasised in Arctic product design, it is important to recognise that not all materials or production processes align straightforwardly with this objective. For instance, glass production is inherently energy intensive and involves constraints that may challenge sustainability-oriented design approaches, even though glass itself is highly recyclable (Siikamäki, 2006). In this study, sustainability is not addressed as an essential quality of glass as a material but rather through the exploration of locally available natural materials, such as snow, within the design process. This shifts the focus from material substitution to examining how context-specific materials can develop design thinking, experimentation, and form development.

A solid understanding of materials, including their technical, sensorial, and manufacture-related characteristics, is essential in product design as it supports informed material selection and the development of meaningful design outcomes (Parisi et al., 2017). Designers also engage with the intangible qualities of materials, such as perceived values, cultural meanings, trends, associations, and emotional responses (Karana et al., 2008). Kirjavainen et al. (2023) describe how nature-positive transformation is an essential requirement regarding the future of material selection for product design, revealing that Arctic product design is closely tied to natural materials. The materials used in Arctic product design are preferably obtained from nearby sustainable sources, since the connection with surrounding nature is so evident (Häkkilä & Johansson, 2018, p. 38). Häkkilä and Johansson (2018, p. 33) highlight the use of natural materials and creating enduring, functional artefacts with, for example, wood, finding applications in both traditional and contemporary contexts in Arctic product design.

Snow, although rarely considered in global design education, offers distinctive possibilities within Arctic design (Yliharju et al., 2020, p. 164). Its material properties, such as temporality, variability, and responsiveness to environmental conditions, enable its use across different stages of the design process, particularly as a processual rather than a structural material. As such, snow can support creative and experimental approaches, opening new perspectives on material-driven processes in Arctic product design.

Arctic Glass Design

Designers working with glass often focus on achieving a balance between form, function, and the unique visual qualities inherent to glass, such as transparency, translucency, and reflectiveness. Glass design encompasses the artistic and functional exploration of creating products, structures, or artworks. Various methods are employed in glass design, including techniques such as blowing, casting, fusing, and kiln-forming, aimed at attaining specific forms and aesthetic outcomes (Bray, 2001). This study focuses particularly on glassblowing techniques.

At the University of Lapland's Faculty of Art and Design, Arctic perspectives are integrated into artistic, design, and research activities, positioning Arctic glass design within the wider field of Arctic product design. Arctic glass design education has been developed there since 2020 (Johansson & Konttinen, 2021). In 2023, UNESCO acknowledged the knowledge, craft, and skills of handmade glass production as an Intangible Cultural Heritage of Humanity (UNESCO, 2023), further emphasising the cultural significance of glassmaking practices.

During 2020–24, design student projects explored Arctic glass design through experimental and thematic approaches. Early projects focused on communicating societal and environmental themes through glass design and on interpreting Arctic conditions through functional objects. The *Protest Glass* project (2020) focused on communicating societal and environmental messages through glass design (Paldanius, 2020). In 2021–22, students explored Northern perspectives by designing dining objects inspired by Arctic conditions (Johansson, 2022). In 2022–23, snow was introduced into the design process through model making, mould testing, and interaction with molten glass. Technical experiments involving snow were presented as part of the *Frozen Glass* exhibition (Väyrynen, 2023). The 2023–24 project continued these explorations and addressed contemporary themes related to the future of design. The exhibition *On Thin Ice: Sustainable Arctic Glass Design* brought together design and environmental concerns, offering a platform to critically reflect on the possibilities and limitations of sustainability in glass design.

In glassmaking, sustainability-related efforts often focus on increasing the use of recycled glass (cullet), improving furnace efficiency, and reducing energy consumption during the production process (Dec & Skorek-Osikowska, 2021). Additional approaches include reducing material waste, limiting the use of pigments or colourants, and sourcing raw materials locally where possible. These strategies can contribute to more sustainable practices, although they remain constrained by the inherently energy-intensive nature of glass production.

Inspiration in Arctic glass design often stems from the region's distinctive characteristics or even stereotypical representations, with thematic essences occasionally imitating natural elements through visual expression, naming, or conceptual framing. Northern themes are evident, for example, in iconic glass designs by Tapio Wirkkala, such as *Fell, Lichen*, and *Northern Lights* (Kalha et al., 2020). Johansson (2024) describes Arctic glass design as *'a specific field within the realm of art and design that focuses on the innovative application of glass, incorporating distinctive characteristics and elements related to the Arctic'*. This includes the integration of artistic expression, cultural reflection, and environmental awareness within the Arctic context.

The connection to Arctic nature is often reflected not only in visual references but also in material considerations. Traditionally, glass has been produced using locally available raw materials, such as sand, reflecting its historical ties to regional resources and production contexts (Bray, 2001). In this study, however, the focus is not on replacing glass itself but on how locally available, natural elements can be incorporated into the glass design process. These may include, for example, reindeer antlers or other context-specific materials that interact with glass during the forming process. In this study, particular attention is given to snow as a processual and context-dependent material, highlighting how its temporary and variable properties can influence form, surface, and design outcomes.

The Snow Glass Technique

The possibility of integrating snow into glass design in the Arctic context creates an interesting connection between experimental techniques and the characteristics of northern nature. Designers and artisans often have practical experience in experimenting with locally available materials in glassmaking processes, and the use of snow in glassblowing is not a new phenomenon. However, systematic research on how snow is integrated across different stages of the glass design process remains limited. In this context, the distinct potential of snow lies not in its status as a material itself but in its ability to take on and transfer form within the design process, for example in mould making and in interaction with molten glass. This study addresses this gap by examining how such processual uses of snow can be applied and understood within glass design practices.

Glass exhibits a unique combination of hardness and fragility and is characterised as an inorganic and amorphous substance. Comprising silica, lime, soda, and other materials in varying proportions, glass encompasses diverse types, such as soda-lime silica glass, borosilicate glass, lead glass, and silica glass, each defined by its component materials (Falk et al., 2011).

The definitions of glass types are based on glass production techniques that convey specific visual characteristics to the glass, such as filigree glass and crackle glass. When conventional glass experiences abrupt temperature variations in the creation process, it undergoes internal stresses that increase its sensitivity to fracture. Blown crackle glass, or *ice glass*, is created by deliberately cracking the hot molten glass surface with water, producing a unique effect. The glass is then reheated, melting the surface into a uniform texture, while the cracks remain visible. This technique was invented around the seventeenth century to conceal glass defects (Weitman & Weitman, 2005). There is existing research (Lötjönen, 2018, p. 1) in which the crackle technique is used with water in an attempt to achieve a strong visual effect without sharp edges; however, comparable studies examining the use of snow in interaction with hot glass remain scarce.

Factors such as temperature, moisture, and snow crystal morphology influence the material's texture and quality, making them essential aspects to consider when using snow in glass design. In this paper, snow glass is discussed as a distinct glassmaking technique. Johansson (2024) defines the snow glass technique as '*a type of glass, which is shaped and manipulated in different ways with snow during the hot glass working process'.* The term does not describe the aesthetic properties of glass, nor does it imply an intention to visually imitate snow (Johansson, 2024). While the snow glass technique introduces novel possibilities for material experimentation, it also involves context-dependent challenges related to seasonality, material variability, and glassmaking processes.

Having outlined the contextual background of *Arctic product design*, *Arctic glass design*, and the *snow glass technique* as interconnected and progressively more specialised Arctic design approaches, the following sections present the three complementary empirical studies. Together, these studies examine the research topic from multiple perspectives, ranging from broader perceptions of Arctic product design to practice-based experimentation in Arctic glass design and practitioner perspectives on the snow glass technique.

Arctic Product Design: A Survey of Design Students' Perceptions

This survey provides contextual insight into how Arctic product design is perceived and defined. As Arctic glass design is examined in this study as a specialised area within Arctic product design, the findings identify themes related to nature, northern materials, and Arctic contexts that form a conceptual framework for interpreting the snow glass technique and the material-driven design approaches explored in the subsequent studies.

Method

The University of Lapland's art and design students were surveyed during 2021–23 to obtain an understanding of their perceptions of Arctic product design and its future directions. Methods were chosen based on their effectiveness in gathering and analysing information. An online questionnaire (Van Selm & Jankowski, 2006) was the primary data collection tool. The methodological approach was selected to efficiently gather targeted insights from the specific demographic, ensuring systematic data collection. This material collection method was convenient as it was conducted during lectures for the *Arctic Art and Design* course. Hence, the participants were well prepared for the topic, and time was allotted to complete the voluntary questionnaire. The questionnaire included the participants' background information along with three open-ended questions related to Arctic product design: the characteristics of Arctic design products, their differences from other products, and future considerations of Arctic design products. The questionnaire was crafted to ensure academic rigour and alignment with the research goals, following established survey methodologies

(Fowler, 2013). The research material underwent content analysis to identify the prevailing themes.

A total of 184 respondents participated in the survey: 136 identified as female, 24 as male, 13 as other, and 11 chose not to disclose their gender. They were aged between 18 and 54 years old, with the modal age falling within the 18–24-year age group (n = 102 aged 18–24, n = 57 aged 25–34, n = 16 aged 35–44, n = 9 aged 45–54). All of the participants were design and art students, while their fields of education were distributed as follows: Fashion, Textile Art and Material Studies (n = 37); Industrial Design (n = 28); Audiovisual Media Culture (n = 28); Graphic Design (n = 27); Applied Visual Arts (n = 27); Art Education (n = 20); and Experience Design (n = 17). The respondents included students from various academic years: first year (n = 144), second year (n = 26), third year (n = 10), fourth year (n = 2), and fifth year or more (n = 2). A total of 177 respondents provided their native locations, representing 72 locations across Finland. Of these, 43% originated from Northern Finland (n = 77), providing a substantial proportion of participants with direct familiarity with Arctic conditions and contexts.

Results

Background information enhances the depth and context of the survey data, enabling more informed and targeted analyses and contributing to the overall validity and applicability of the research findings. Given the majority of female respondents (74%), the distribution aligned with the overall gender distribution of Art and Design students at the University of Lapland as reported by Statistics Finland (Tilastokeskus, 2023), where 78% of students were reported as female and 22% as male.

The respondent sample primarily consisted of young adults, as the majority fell within the 18–24-year age group. The age group of 25–34-year-olds was also sizable, while the 35–44 year and 45–54 year age groups constituted a clear minority. The respondents were fairly evenly distributed by education programme, representing students from different design fields. Approximately 78% were in their first academic year. This distribution suggests that many of the respondents might have had limited knowledge due to their early academic stage; however, the study primarily sought to gather student perspectives rather than evaluate their expertise. The results are presented below according to each survey question.

1. What kinds of properties do you think an Arctic design product has?

According to the respondents, Arctic design products emphasise sustainability, ecological considerations, and the principles of sustainable development. Properties such as closeness to nature and durability reflect the unique features and cultural viewpoints of the Arctic region. The characteristics of Arctic design products embody values associated with locality and Nordic design traditions. The respondents highlighted the significance of minimalist, clean designs alongside Nordic design aesthetics characterised by timeless forms and neutral colour palettes. The findings underscore the importance of practicality and functionality, demanding adaptations for Arctic conditions. The use of northern, natural materials and crafts further highlights the region's cultural heritage and respect for traditions. Although the question focused on the properties of Arctic design products, several responses extended beyond product characteristics to address underlying values, material choices, and design approaches. The most prevailing properties were *sustainable and ecological*, *natural*, *functional*, *optimised for Arctic conditions*, *minimalistic and aesthetic*, *place-based and culturally grounded*, *northern nature-based materials*, and *authentic.* Example response:

> Arctic product design reflects the cultural heritage, values, and vulnerability of the Arctic region due to, among other things, climate change. The products most often feature local materials that can be found in nature (wood) or imitate the structure and appearance of ice and snow (glass). Arctic art takes a stand.

While some responses associated glass with Arctic materials due to its visual resemblance to ice and snow, glass itself is not a locally sourced or traditionally Arctic material. In this study, the Arctic context is instead approached through the integration of locally available natural materials into glass design processes.

2. How do you think Arctic design products differ from other products?

According to the respondents, Arctic design products are distinguished by durability and practicality inspired by northern environments and their materials. Characteristics such as minimalist and nature-inspired aesthetics, northern craftsmanship, and cultural references were associated with local identity and Nordic design traditions. Authenticity, originality, sustainability, and responsibility were also emphasised, often reflecting an appreciation for nature and environmental awareness. Symbolic references to Arctic elements, such as ice and snow, frequently appeared in the responses, while nature and northern regions were described as important sources of inspiration. The most commonly recurring themes included *nature and northern materials*, *locality and cultural heritage*, *minimalistic aesthetics and design*, *sustainable quality and durability*, *functionality and usability*, *authentic identity and expressiveness*, *values*, and *responsibility.* Example response:

> Specifically, Arctic product design stands out from others in its connection to nature and "honesty". While well-crafted products are found globally, Arctic design is one of the few that achieves this outcome in an environmentally friendly and natural manner, often utilising natural materials.

While some responses emphasised visual and symbolic references to Arctic elements, such as ice and snow, these primarily reflected representational rather than material- or process-based approaches to engaging with Arctic environments.

3. What do you think should be considered in Arctic design products in the future?

The respondents emphasised sustainability, ecological responsibility, and lifecycle thinking as important future considerations in Arctic product design, reflecting a growing environmental awareness and interest in sustainable alternatives. Climate change, environmental protection, and the use of natural or recycled materials were frequently highlighted alongside responsible production methods and long-lasting design solutions. The responses also stressed the importance of preserving local culture, traditions, and northern identity within future design practices. This may stem from a respect for the unique identity of the Arctic region. The most commonly recurring themes included *environmental sustainability and responsibility*; *local identity, culture, and northern context*; *aesthetic values and design expression*; *quality, durability, and meaningfulness*; *material choices and natural resources*; *future orientation and societal impact*; *user-centred and functional design*; and *global relevance*. Example response:

> Greater attention should be paid to ecological considerations, recyclability, and the impacts of climate change, both for the product itself and in its manufacturing processes. In addition, the importance of maintaining critical design should not be overlooked.

These responses concern Arctic product design more broadly and therefore do not directly address sustainability considerations related specifically to glass production processes.

Arctic Glass Design: Design Practice Observation

The second part of this study explored how snow can be applied within Arctic glass design processes. This empirical section is based on collaborative experimentation, observations, and practical experiences involving design students and participating instructors. The aim was to investigate how snow influences material interactions, form development, and glassmaking processes within Arctic glass design practices.

Research Approach

Empirical data were collected through collaborative experimentation integrating snow into Arctic glass design processes. Observation (Vilkka, 2018) played a central role in documenting how the participants approached material experimentation, encountered challenges, and developed solutions while working with snow in glassmaking. The practical design sessions enabled hands-on testing of how snow could be applied at different stages of the glass design process.

Figure 2 .

Students experimenting with the snow glass technique.

Note. On the left, snow evaporates upon contact with molten glass, creating surface patterns. On the right, a student throwing snow during the glassblowing process. Photographs by student Annu Kuivas (left, 2024) and Milla Johansson (right, 2024).

The data were documented through observation and process-oriented documentation focusing on material interactions, design practices, and the resulting outcomes. Documentation plays a key role in articulating experiential knowledge in practice-led research, and methods such as photography and reflective notes support conscious reflection on design processes and help transform tacit experiences into communicable research insights (Mäkelä & Nimkulrat, 2018). In this study, the documentation included photographs and written notes that captured key moments, emerging themes, and material interactions throughout the design process (Figure 2). The design students wrote descriptions accompanying the resulting works, presented both in exhibitions and online. Photographic documentation of material experiments was used to support the analysis of processual interactions between snow and glass. As the experimental work was conducted collaboratively by the design students and participating instructors, the researcher adopted a participatory observer role throughout the shared material experimentation process. The analysis was conducted by the researcher and focused on material interactions and processual developments rather than on individual participants' reflections.

Research Context

Potential applications of snow were explored within Arctic glass design processes across multiple stages, including ideation, prototyping, mould making, design testing, and production. Observations conducted during the 2020–21 and 2021–22 academic years focused on how snow could be integrated into the early stages of the design process, while the direct interaction between snow and molten glass during glassblowing was explored in subsequent courses during the 2022–23 and 2023–24 academic years. A total of 19 design students and two instructors from the University of Lapland participated in the study during the 2022–23 (n = 9 students, n = 2 instructors) and 2023–24 (n = 10 students, n = 2 instructors) academic years. The collaborative experimentation carried out by the students and instructors provided an empirical basis for examining material-driven processes within Arctic glass design.

As glassmaking studios are not available in Finnish Lapland, the experimental work was conducted in collaboration with a partner institution in Nuutajärvi (Tavastia Vocational College), where glass objects were realised in a prototype workshop. These workshops brought together artisan students, design students, and instructors in collaborative, studio-based glassblowing practices, supporting the development of glassmaking expertise and the materialisation of design concepts in molten glass (Hulkkonen et al., 2025). The concepts developed by the design students were made in collaboration with artisan students who were responsible for the glassblowing process under instructor supervision. The glass objects were created by a team rather than by a single glassblower. In addition, collaborative experimentation with the snow glass technique was conducted in 2023 at Ikaalinen (Sasky Ikaalinen College of Crafts and Design), involving an artisan student and instructors.

Findings and Design Outcomes

Snow can be integrated into Arctic glass design processes across multiple stages and in diverse ways when temperatures and snow conditions are suitable. The experimental work conducted during 2022–24 was aligned with seasonal conditions to enable the use of snow in glass production. Working with snow requires situational awareness, adaptability, and embodied decision-making, as its properties change in response to temperature, moisture, and handling. Beyond serving as a source of inspiration, snow can actively influence form development and surface qualities through its interactions with glass.

Snow can be employed in the early stages of the design process to explore form, for example as a temporary medium for shaping and testing ideas (Figure 3). In this context, it functions as an alternative to commonly used synthetic materials, such as plastics or foams, in initial form-finding processes. As a result, using snow for creating ideas and finding shape can be a quick, environmentally friendly, and economical option. Its use enables rapid and flexible experimentation, as forms can be created and modified quickly while also reducing the need for additional materials in early-stage experimentation. Equally, snow can be used to modify the surface of the model or mould, if the material allows.

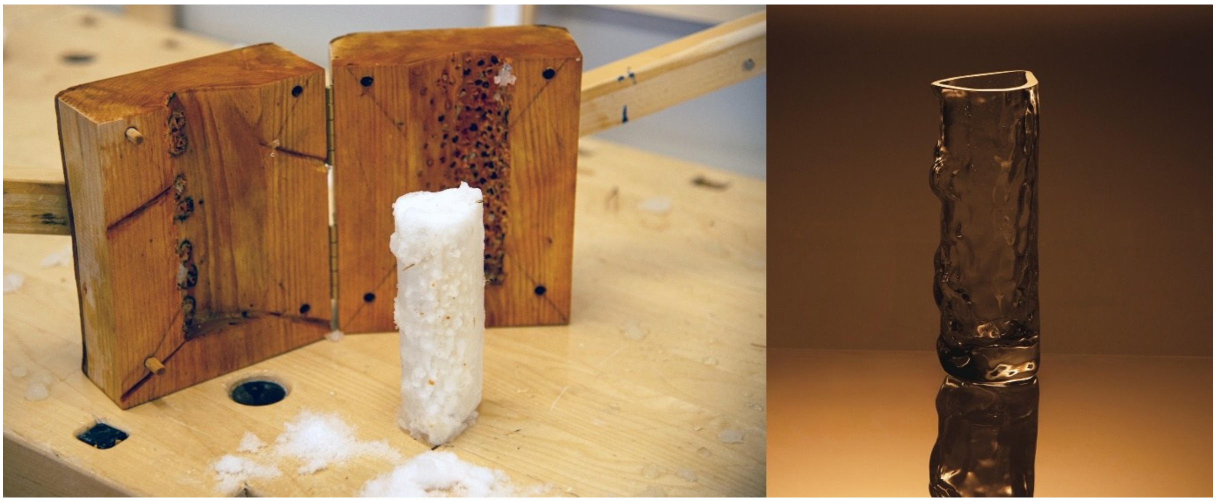
Figure 3

Suitable snow conditions enable form exploration, illustrating snow's role in the glass design process (left). The resulting glass objects are shown on the right.

Note. Design and left photograph by student Erika Turunen (2020); right photograph by students Erika Turunen and Topi Juusola (2020).

Figure 4

A glassblowing mould can be tested and refined by examining its shape with snow.



Note. The resulting glass object is shown on the right. Design and left photograph by student Annu Kuivas (2024); right photograph by students Annu Kuivas and Jutta Kotala (2024).

Figure 5

Using snow in diverse ways in the glassblowing process.

Note. From left to right: Glassblowing into a freely shaped snow mould (left); design and photograph by student Netta Kandelin (2023). Reindeer antler and snow as mould components (centre); design by Milla Johansson and photograph by student Sami Mikkola (2023). Molten glass dipped into snow before blowing (right); photograph by student Juuso Kiviniemi (2023).

In prototyping and mould making, snow supported the participants' iterative learning by allowing the rapid testing and revision of design ideas, making material feedback visible and tangible. An effective method for pre-assessing glass design is to pack snow into the mould and examine whether the shape aligns with the intended design (Figure 4). Snow models could also potentially be employed in user tests to seek the views of target groups.

The melting and transformation of snow introduced uncertainty into the process, highlighting the temporal and fragile nature of working with it. Although the snow was initially expected to melt rapidly upon contact with hot glass, the experimental observations revealed that snow moulds could withstand repeated blowing cycles under specific temperature conditions. During the experiments, molten glass remained in contact with the snow for approximately 3–6 seconds, while the snow surface temperature ranged between –3°C and –10°C. Under these conditions, the snow retained its form surprisingly well instead of immediately melting into water, highlighting the distinctive thermal behaviour of snow within glassmaking processes. These characteristics became part of the learning experience rather than obstacles to be avoided. It is important to underline the melting and quality changes of snow when exposed to hot air or materials.

Nevertheless, snow can be used in diverse ways in the glass production process. The mould itself can be made from snow, with the molten glass being blown directly into it to achieve a specific form or effect (Figure 5, left). Typically, glass is designed for easy detachment from the mould; however, in the case of a snow mould, breaking may be required post-blowing. Alternatively, snow can be incorporated as only part of the mould, resulting in varying textures and patterns on the glass (Figure 5, centre). Furthermore, a pattern can be imprinted into snow using a template, onto which hot glass is subsequently blown. Before shaping hot glass into its final design, it can be dipped into snow for varying durations, subjected to different movements and pressures, and reheated in the furnace for moulding (Figure 5, right). However, heating glass to the necessary temperature for reshaping is challenging due to rapid cooling when in contact with snow. Temperature fluctuations can lead to variations in glass thickness. The intricate patterns melt, almost dissolving, but leave distinct motifs on the glass, which are particularly visible as shadows (Figure 6).

Figure 6

The snow glass technique creates vivid shadows. Design and photograph by student Netta Kandelin (2023).

Delicate contact between hot glass and snow, without movement, can produce lichen-like traces on the glass surface (Figure 7), but there is a risk of the pattern going through the glass, leading to its fracture. Observations indicated that thicker glass sections better resisted thermal shock, while thinner areas remained more vulnerable. Contact duration also emerged as a significant factor, with a proportional increase in impact with prolonged exposure. In experiments involving manipulating glass with cold water, parameters such as glass thickness, the amount of glass surface in contact with water, and reheating serve as metrics (Lötjönen, 2018, p. 3). In this study, however, factors such as temperature, contact time, and reheating were monitored and documented within the experimental setting rather than controlled under laboratory conditions.

Figure 7

Contact between snow and hot glass creates lichen-like surface patterns.

Note. Left design by Milla Johansson and photograph by student Juuso Kiviniemi (2023). Right design and photograph by student Juuso Kiviniemi (2023).

Figure 8

The quality of snow (from left to right: powder, soft, and hard snow) and the interaction techniques used with glass are reflected in the resulting surface characteristics.

Note. Design and photographs by student Netta Kandelin (2023).

Both human and material movement play essential roles in glassblowing, a process studied by Hulkkonen et al. (2023, p. 8), revealing that the glassblower's work is in relation to the actively moving material. In this study, the observations emerged from collaborative, practice-based experimentation involving both design students and instructors. Hot glass can interact with snow through movements such as rubbing or rotating, with rotation either confined to a single spot or by moving the glass across new snow. Observations indicated that the pattern can vary depending on the technique used (Figure 8). Further tests should be conducted to examine this phenomenon in more detail.

Figure 9
Different pattern effects can be achieved by controlling the technique of applying snow onto hot glass.

Note. The left glass object was produced at Nuutajärvi, whereas the centre and right glass objects were produced at Ikaalinen. Design and photographs by Milla Johansson (2023).

Snow can be scattered or applied onto hot glass with different quantities, movement, and force. The longer and more prolonged the contact between snow and glass, the more pronounced the effects that are achieved. There are indications of a distinctive, sequin-like trace that can be achieved by throwing snow onto the glass during the blowing process, an effect that requires further experimentation in the future (Figure 9).

The findings indicate several key considerations in applying the snow glass technique:

- quality of snow, influenced by various elements—temperature, humidity, texture, and structure
- quality of glass—temperature and thickness
- time and timing—duration and stage of contact between snow and glass
- movement—controlling the interaction between glass and snow in different ways
- finishing—snow effects are either retained or smoothed through glass reheating

Whereas water produces a crackled surface effect, snow leaves distinctly different marks in glass. Snow patterns appear irregular and lichen-like, while water-based crackle patterns appear more systematic. These differences were also recognised in reflective discussions with the participating students following the workshops. Further research is crucial for obtaining nuanced results. Unlike water, snow can also be shaped and manipulated into precise, repeatable forms, representing one of the study's most distinctive and novel findings. In the post-workshop discussions, some students highlighted the potential of this characteristic for developing controlled patterns with snow. These characteristics suggest clear artistic potential for the snow glass technique while also indicating possibilities for small-series product applications.

Snow Glass Technique: A Survey of Experienced Practitioners

In the third part of this study, an additional survey was conducted with artisan students and glassblowers who had experimented with the use of snow in glassblowing, including both participants from the workshop activities described above and individuals involved in separate snow glass experiments conducted independently during their studies or professional practice. The aim was to examine their experiences of using snow within glassblowing processes, focusing on the perceived characteristics of snow glass, its distinctions from other glassmaking approaches, and the challenges and future possibilities associated with the snow glass technique (Johansson, 2024). The survey provided complementary practice-based perspectives on the snow glass technique.

Method

An online survey was used to collect practice-based experiences from artisan students and glass practitioners who had experimented with the use of snow in glassblowing. The survey complemented the collaborative experimental findings by providing additional practitioner perspectives on the snow glass technique. The material was analysed using qualitative content analysis to identify recurring themes, characteristics, and observations.

Study Setup

For efficient data collection, existing professional contacts were approached at the turn of 2023–24 via email containing a link to the online survey. Seven responses (n = 7) were received through the questionnaire, while one participant (n = 1) chose to discuss the topic via email correspondence. These discussions are included in the results where relevant. Informal discussions also took place with professional contacts; however, due to limited documentation, they are referred to only as supplementary observations.

The respondents included five females (n = 5), one male (n = 1), and one respondent who preferred not to disclose their gender (n = 1). Their ages ranged from 18–24 years (n = 1) to over 65 years (n = 1), with participants also represented in the age groups 25–34 years (n = 2) and 55–64 years (n = 3). The respondents represented diverse educational backgrounds, including design education at different levels, glass artisan education, and vocational teacher education, with some participants having multiple educational backgrounds. Experience in glassblowing ranged from less than one year (n = 1) to over twenty years (n = 2), with additional participants reporting one-and-a-half years (n = 2), two years (n = 1), and three years (n = 1). The respondents answered five open-ended questions:

1. How have you utilised snow in glassblowing?
2. What characteristics do you associate with snow glass?
3. Does snow glass differ in characteristics from other types of glass?
4. What challenges or potential opportunities do you foresee for snow glass in the future?
5. How would you define snow glass?

Results

Given the limited sample size, the findings should be interpreted as indicative rather than generalisable. Nevertheless, the participants represented diverse backgrounds and varying levels of glassblowing experience, providing a range of practice-based perspectives on the snow glass technique. Several participants also combined practical expertise in glassmaking with higher education in art and design, contributing broader reflections on the topic. The results are presented below according to each survey question.

1. How have you utilised snow in glassblowing?

The respondents had experimented with how snow influences the behaviour and appearance of glass, particularly in creating crackled surfaces and other visual effects. Snow was applied both inside and outside the glass by sprinkling it onto surfaces, pressing or embedding objects into it, and incorporating it within blown pieces. Snow was also used as a temporary mould, for example by shaping cavities in snow and blowing glass into them. Overall, the respondents described multiple ways of integrating snow into glassblowing processes.

2. What characteristics do you associate with snow glass?

According to the responses, snow quality notably affects glass behaviour and the markings it produces, while glass temperature influences the resulting form and texture intensity. Applying snow during the later stages of the glassblowing process allows greater flexibility in controlling the visual effect, whereas reheating softens the markings produced by snow. The respondents also noted that sprinkling snow onto glass creates effects distinct from traditional water crackling, particularly in the way snow glass reflects light. Snow glass was described as an intriguing and novel experience; however, glass thickness was considered important, as thinner forms may not withstand thermal shock. Some respondents observed both similarities and differences between patterns created with snow and those produced through water crackling.

3. Does snow glass differ in characteristics from other types of glass?

Snow glass was described as a distinctive form of glass expression characterised by sparkling, tactile surfaces and light-refracting qualities. Some respondents compared its characteristics to water-crackled glass while also emphasising differences in texture and visual appearance. Although snow glass was considered suitable for functional objects, the respondents highlighted the importance of durability and safety considerations, particularly regarding glass wall thickness. The distinctive characteristics of snow glass, together with its potential to introduce alternative visual and material qualities into glass design, suggest opportunities for further exploration within the field.

4. What challenges or potential opportunities do you foresee for snow glass in the future?

Several challenges related to the snow glass technique were identified. Ensuring the year-round availability of snow was considered a key concern. In addition, large-scale or mass production may present practical difficulties, suggesting that the technique is more suited to artistic or small-batch production contexts. The risk of material breakage was also highlighted as a notable limitation associated with snow glass. At the same time, the findings revealed multiple opportunities. Snow glass enables the creation of shapes, patterns, and surface qualities that may be difficult to achieve through conventional techniques. Using snow as a mould allows flexibility in shaping glass due to its plasticity and the ease with which moulds can be broken and reconstructed. The respondents also associated the distinctiveness of snow glass with possibilities for branding and commercial differentiation. Furthermore, snow glass was seen as a way to incorporate local Arctic characteristics into product design, strengthening regional identity and contextual relevance.

5. How would you define snow glass?

Snow glass was described as a novel and captivating glassmaking technique that incorporates snow into different stages of the glassmaking process. The respondents associated it with a distinctive interplay of predictability and surprise, producing characteristics partly comparable to water crackling while maintaining subtle and unique visual qualities. Snow glass encompasses multiple applications, including shaping, texturing, and crackling glass. Overall, it was characterised as an intriguing design approach with both visual fascination and possible symbolic value.

In addition, face-to-face discussions with experienced glassblowers were conducted in various locations across Finland (Rovaniemi, Nuutajärvi, and Ikaalinen), Norway (Tromsø), and Iceland (Reykjavik) during 2023. The glassblowers generally noted that working with water, ice, or snow was previously known within experimental glassmaking practices. Although snow was not considered fundamentally distinct from other experimental materials, the participants recognised its potential for shaping glass and expressed interest in its further exploration.

Discussion

The findings based on the first dataset—student responses concerning the characteristics of Arctic product design—highlight a strong association with nature. The responses suggest that Arctic product design is understood not only through product attributes but also as a process-oriented and context-sensitive practice shaped by values, materials, and local conditions. This emphasis on nature can be interpreted through the dual perspective proposed by Kalha (2020), which considers both visible elements in objects and the underlying value systems embedded in cultural practices. While glass is sometimes associated with Arctic design through visual or symbolic references, it is not a locally sourced or traditional Arctic material. In this study, the Arctic context is instead approached through the integration of locally available natural materials, such as snow, into glass design processes.

The findings indicate a tendency to associate Arctic product design primarily with nature-based and traditional narratives, while more complex contemporary and urban Arctic perspectives remain less visible. At the same time, the responses emphasise the importance of context-sensitive approaches that engage with local materials, environmental conditions, and regional characteristics. These perspectives reinforce the understanding of Arctic product design as a situated practice shaped by the relationships between place, material, and making. They also provide a useful context for interpreting the snow glass technique. Rather than treating Arctic conditions as symbolic references represented in finished objects, the subsequent studies demonstrate how Arctic environmental conditions can become materially embedded within the design process itself.

The findings from the second dataset highlight how the participants engaged with snow across multiple stages of the glass design process, including form exploration, mould making, and interactions with molten glass. Rather than functioning solely as a visual reference to

Arctic nature, snow became a processual element that directly influenced material behaviour, form development, and surface qualities. This suggests that snow can shape design not only through symbolic representation but also through its active participation in material processes. Descriptions accompanying the resulting works by the design students also reflected connections to Arctic environments, natural phenomena, and locally grounded material experiences. Together, these findings suggest that integrating locally available natural materials into glass design processes can support context-sensitive approaches.

Snow functions as a context-specific material whose distinctive properties open possibilities for experimental approaches in glass design (Johansson, 2024), as demonstrated in the second and third datasets of this study. When working with a temporary material, such as snow, its momentary and unstable nature becomes an active contributor to both the process and the resulting designs. While similar visual effects can be achieved by applying water to hot molten glass, the empirical findings indicate that the snow glass technique is distinguished by three key characteristics: the morphology of snow crystals, which generates irregular, lichen-like textures; the plasticity of snow moulds, allowing intentional fragmentation and reformation; and the possibility of repeatability through the use of templates. Together, these characteristics suggest that the role of the designer shifts from controlling material outcomes towards negotiating possibilities with the material itself.

Reflective discussions with the participants frequently highlighted the unpredictability of snow as both a challenge and a source of creative potential. Rather than simply serving as a medium through which predefined ideas were realised, snow influenced decision-making throughout the design process, shaping possibilities for form exploration, mould making, and surface development. These observations support material-driven perspectives that recognise materials as active contributors to design processes rather than passive resources (Karana et al., 2015). At the same time, the findings challenge the assumption that working with temporary and naturally variable materials necessarily limits control or repeatability. Rather, control shifts towards a negotiated relationship between designer and material (Ingold, 2013; Karana et al., 2015) in which variation becomes an inherent part of the design process rather than a deviation from it. Using templates, the snow glass technique demonstrates how variation and repeatability can coexist, positioning material variability as a potential value rather than a limitation. This observation broadens the potential applications of the technique beyond unique artistic works towards small-series design production.

By linking environmental conditions with studio-based practices, the snow glass technique blurs the boundary between context and making, foregrounding the role of locally available and temporary materials within glass design processes. Rather than positioning glass itself as a sustainable material, the findings emphasise how snow can function as a locally grounded processual element within Arctic glass design. At the same time, sustainability cannot be reduced solely to material selection but must also be considered in relation to design intentions, longevity, reuse, and broader circular design principles. The glass objects produced in the study were primarily realised in clear glass, which supports material recyclability and future reuse. These considerations were reflected in the students' design concepts and accompanying project descriptions, many of which engaged with environmental themes reflecting on human relationships with nature and contemporary sustainability challenges.

Taken together, the three parts of this study suggest that Arctic product design can be understood as a materially grounded and context-aware practice shaped by relationships between place, material, and making. The integration of material experimentation and practitioner perspectives highlights how locally available materials, such as snow, can influence glass design processes across multiple stages. The practitioners' perspectives also reinforce and complement the collaborative experimental findings. Together, these findings position the snow glass technique as a context-specific approach within Arctic glass design practices. In this way, the snow glass technique extends discussions on Arctic product design beyond questions of symbolism and identity, highlighting how Arctic environmental conditions can actively shape both design processes and outcomes. As Arctic environments continue to change, the technique also reminds us that the future of design depends not only on the materials we choose but also on the materials that remain available to us.

Limitations and Future Work

This study was limited by the seasonal and context-dependent nature of snow, which affects the availability and consistency of the material during glassmaking processes. Variations in snow quality, temperature conditions, contact duration, and reheating also influence the resulting surface qualities and forms, making exact repeatability difficult within practice-based experimental settings. While the findings identify several distinctive characteristics of the snow glass technique, further research could expand and deepen understanding of these material interactions through broader and more controlled experimental settings. Future studies could examine controlled pattern formation, repeatability, and the influence of specific variables, such as snow type, glass thickness, and thermal conditions, in greater detail. Expanding the empirical base through collaboration with a broader group of experienced glassblowers and designers would further strengthen understanding of the practical applications and limitations of the snow glass technique.

Conclusions

This study examined how a material-driven design approach using the snow glass technique can shape design processes and outcomes within Arctic product design. The findings indicate that Arctic product design is strongly connected to local contexts, including relationships with nature, materials, and cultural environments. These relationships also resonate with culturally sensitive and planetary design perspectives that emphasise awareness of local conditions, material contexts, and environmental interdependencies within Arctic design practices. Within this framework, Arctic glass design offers a concrete context for exploring how locally available and temporary natural materials can be integrated into glass design processes.

The study also demonstrates how snow can function not only as a visual or symbolic reference to Arctic environments but also as a processual element that actively shapes material behaviour, form development, and surface qualities during glassmaking. Through collaborative experimentation and practitioner perspectives, the snow glass technique emerged as an example of how place-specific materials can influence multiple stages of glass design, including form exploration, mould making, and interactions with molten glass.

The findings suggest that the snow glass technique possesses several distinctive characteristics, particularly in relation to the morphology of snow crystals, the plasticity of snow moulds, and the potential for repeatability through templates. While similarities to water crackling were identified, snow was also recognised as producing distinct textures and visual qualities. In this context, the study contributes to ongoing discussions on material-driven and context-sensitive approaches within Arctic glass design while highlighting opportunities for further experimental research on snow in glassmaking practices.

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