DIVERSE (DIGITAL) TEXTILE DESIGNING MODELS AND THE UN-/TOUCHABLE LEARNING EFFECTS

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ABSTRACT

Today the industry and the user are facing virtual spaces as parallel world to the physical experience. This scoping paper explores how digital and AI-driven simulations translate textile tactility into visual form, inviting users and designers within industrial creation processes to 'feel' through vision. Drawing on the concept of 'Material Mind' (by Wachs, M.E.) from 2008, with the statement 'thinking of material, is touching material', we are facing how this concept evolves in the context of digitalisation. As a diverse disciplinary and didactically diverse design project, this scoping paper focus on integrative interactive hybrid design and learning space for diverse users. These new forms of 'co-ideating' can be evaluated as embodied social knowledge spaces, where aesthetic meaning is co-created through diverse media, diverse senses and diverse didactically creation spaces and with respect to diverse culturally symbolic values. Bringing diverse perspectives of the user, the designer, and the industries into a discussion for resilient future, via 'co-ideating' as both designing and educational creation spaces, provides a deeper understanding of perceptual processes. Integrating Human-Centred Aesthetic Systems (Human-CAS by Rem, K.) enables a deeper understanding of aesthetic transitions grounded in embodied, cognitive, and diverse cultural competences in digital areas. New divers Co- designing and learning spaces and methods are describing the new significance of a 'textile mind'.

Keywords: Embodied craft knowledge, haptic experiences in virtual spaces, diversity and participation in designing media, crafts designer & cultural diversity in industry, human-centred aesthetic systems

1 INTRODUCTION - THINKING MATERIAL IS TOUCHING MATERIAL?

This scoping paper envisions how digital and AI-driven simulations translate textile tactility into visual form - inviting consumers and industrial designers to 'feel' through vision. Drawing on the concept of Material Mind with the statement 'thinking of material, is touching material' from 2007 [1], we are facing 20 years later, how this concept evolves in the context of digitalisation. Today an inflationary perception of value is observable [2], in which raw materials are losing their significance. Through interdisciplinary designing systems, proclaimed through 'tool driven' case studies - denim upcycling methods, recovering textiles made of cotton grass (see chapter two) -, digitally mediated textile industrial usage and visions in industry (see chapter three), and a theoretical integration of virtual Human-Centred Aesthetic Systems (see chapter 4), new hybrid 'co-ideating spaces' (not co-working spaces) are triggered by the user and 'crafts designer'. All three stakeholders work collaboratively: next-generation students and engineer experts from industry and user, this was just examined by interdisciplinary courses. That builds the base for integrated educative hybrid processes of learning and of perception. With the help of the defined model from 2008 'thinking material is touching material', a further evolved system in imagining material through virtual representation gives room for remembering un-/ touchable material attributes through virtual experience of textile materials. Within the cultural and traditional contexts, textile technologies and resilient production processes are predominant factors [3] for products which are associated with higher quality and higher attraction by the consumer. This is based on embodied experiences and the frame of collective remembrance [4] of people, diverse spaces – analogue, digital and metaphorical – are creating in the post-digital era a new model of 'textile mind' [5]. As a diverse disciplinary and didactically diverse design project, this project-based course is showcasing an integrative interactive hybrid design learning model. Diverse perspectives - by the user, the designer, and the industries via co-ideating spaces as both designing and educational creation spaces - provide opportunities for a deeper understanding of perceptual processes by diverse stakeholders. Starting with re-innovative, body-involved handmade designs as vision: Figure one (1) simultaneously demonstrates and evokes embodied knowledge [6] and the hand-brain coordination involved in sketching future visions, by using co-designing experiences and the development of 'human body – machines driven – co-designing' – this was shown at the Dialogwerkstatt at WDC – World Design Capital 2026 for example (see fig.1-3). It leads to crafts knowledge as trigger for innovative design and participative design.

2 DENIM UPCYCLING - INNOVATIVE CRAFT PRACTICES AS DRIVERS

The textile heritage of craftsmanship is the origin of the textile industry and thus an essential foundation for future-oriented design education [7]. The processes of craft practice involve implicit, embodied knowledge that is often intangible and challenging to articulate [8], yet crucial for learners to understand, evaluate, and navigate today's complex industrial practices [9]. The foundations of craftsmanship are embodied by experience-oriented and value-oriented learning in education, thereby enabling students to develop essential skills for managing values within industrial contexts [10]. The denim upcycling study is used to demonstrate how embodied textile craft knowledge can be applied in the field of design education. It examines hybrid methods that combine craft techniques, such as crocheting, with industrial processes, such as laser cutting, as educational tools [11]. As illustrated in Figure one (1) the digital file is translated into cuts by the laser cutter, with the resultant stripes then being crocheted together by hand with a crochet hook. The development of this technique is fully demonstrated in the outfit depicted on the right of Figure one (1). These processing techniques and methods enable students to translate their personal and cultural values into industrially relevant solutions by fostering slow design [12], co-design [13] and adaptive thinking [14]. This approach fosters reflective and diverse decision-making processes, which extends beyond the confines of purely digital modelling environments. In contrast, the process of hand-crafting exposes designers to uncertainty, resistance, and tactile feedback, whereas purely digital creation simulates pre-controlled material properties. These material negotiations require iterative adjustment and embodied judgement, generating tacit and relational knowledge that exceeds algorithmic prediction. By engaging directly with materials - by simultaneously reassessing the thesis from even 20 years ago 'thinking material is touching material', and processing through integrating craftsmanship in combination with industrial practices, a material-minded approach is cultivated. Therefore, designers are encouraged to become not only technically proficient, but also systemically relevant contributors capable of shaping resilient and meaningful industrial practices [15].


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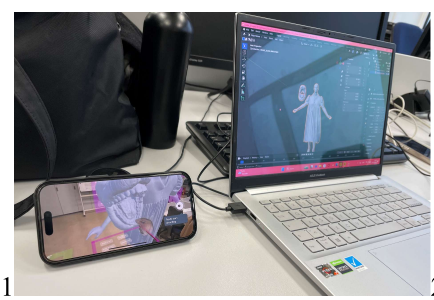
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Figure 1. Digital laser cut file, prototype of hybrid 'Cut and Crochet'-Technique; Outfit 'Structear' (c M. Lemper). Figure 2 & 3. digital – analogue x design experience; costume: the Cry, WS 2024/25

3 TACTILITY, CRAFT AND DIGITAL TRANSLATION IN DESIGN PRACTICE

At the beginning of the 20th century, products were primarily categorised and evaluated according to their visual appearance. Visual aesthetics like the shape or colour of a product played a decisive role in customers' purchasing decisions. With the increasing diversification of product ranges, production methods and material options, however, additional sensory dimensions have become central to product perception and selection [16]. In the past, for example, a wooden table was typically made of solid wood, offering limited variation. Today, a table with a wooden appearance may assume almost any form or scale and can be produced from a wide range of materials, including plastics that visually simulate wood. As a consequence, tactile perception has gained importance as a key factor in purchasing decisions and

referencing to high quality in design and the atmospheric interpretation. Tactile sensation does not only refer to the immediate sensory experience of touching a material but is also closely linked to product functionality - such as ease of handling or comfort in use. While such functional tactile aspects can be comparatively well assessed and integrated into the design process through user research, sensory-affective tactile perceptions are far more complex. The evaluation of whether a material feels pleasant or meaningful is shaped by embodied, cognitive and cultural factors, including age, gender, social background and cultural identity. These dimensions of diverse triggered embodied perception are less predictable, yet they play a crucial role in aesthetic judgement and decision-making [17]. Material surfaces may be individually perceived as rough or smooth, warm or cold, sticky or slippery. In textiles in particular, production methods and internal material structures significantly influence surface qualities and tactile aesthetics [18]. As discussed earlier, textile heritage is deeply connected to craftsmanship and embodied cultural knowledge. Crafted materials - such as handwoven wool fabrics - are often perceived as carrying greater aesthetic and symbolic value than man-made fibres and industrially-produced textiles, even if identical raw materials are used. Visual and tactile indicators of craftsmanship thus contribute to the co-creation of aesthetic meaning and to the perception of higher product value [19].
Within contemporary design practice, AI-driven tools increasingly support design processes by accelerating workflows and aligning outcomes with user preferences [20]. However, translating virtual design simulations into meaningful physical products requires AI systems to be trained on deep material understanding [21]. In textile design education, this underscores the continued importance of teaching craftsmanship techniques and textile history. Such embodied knowledge [22] enables students to critically evaluate AI-generated design proposals and to actively shape Human-Centred Aesthetic Systems (see chapter 4). The loss of historical knowledge related to colours, patterns, and textile techniques would therefore not only weaken cultural heritage but also limit the development of resilient digital design practices and minimise a longevity of high quality of value-driven designed products and product languages [23]. In this respect, parallels can be drawn to inclusive design approaches, which shift from the task of adjusting individuals to fit in a system to adjusting the system so everyone can fit in [24]. Hybrid co-working and co-learning spaces should create accessibility to bring together academia, industry and craftsmanship to integrate embodied material knowledge with advanced digital technologies [25].

4 EMBODIMENT, PERCEPTION & SENSORY INTELLIGENCE

4.1 Embodied Perception and Aesthetic Meaning in Virtual Design Learning

This paper adopts theoretical and speculative research, aiming to establish a conceptual framework for diverse ideating spaces. The objective is to ensure that future generations of designers are well informed about cultural meanings and tactile feel and feedback while simultaneously working within contemporary design practices, which are increasingly inseparable from artificial intelligence [26].
When considering the increasing integration of digital media in design education over the past decade, indications emerge of a gradual transformation in the role and relevance of physical artefacts such as sketching tools, fabrics, books, and other material media. Rather than a complete disappearance, these artefacts may become recontextualised within hybrid educational environments that combine innovative physical (see chapter 2) and digital modes of learning. How can embodied sensory intelligence and culturally embedded craft traditions - historically shaped through prolonged physical interaction with materials - be meaningfully supported in learning environments where sensory input is reorganised through virtual mediation? While contemporary VR interaction systems increasingly incorporate multisensory and sensorimotor feedback, they differ fundamentally from direct material engagement, particularly regarding resistance, texture, and material agency. In this context, the question is not whether embodiment disappears, but how forms of embodiment are transformed within virtual learning systems [27].
Regarding the acquisition of aesthetic competence during comprehensive design education, students undergo multiple stages of learning how aesthetics are constructed and how they are perceived by users of designed artefacts. These competencies are subsequently applied when entering professional industrial contexts. Designing products within corporate environments requires the creation of artefacts that are user-friendly, aesthetically coherent, and intuitively understandable for a company's specific target group [28]. For this purpose, the term 'Human-Centred Aesthetic Systems' (the author) is proposed as a conceptual framework rather than a prescriptive model. It is intended to support analytical

reflection on how aesthetic meaning emerges from the interaction of embodied perception, cultural background, emotional response, and contextual use, rather than to define a universal or measurable system. The following definition is proposed: Human-Centred Aesthetic Systems (Human-CAS) are systems applied during the design and creation of products, services, or experiences. They describe the holistic integration of human well-being, needs, perceptions, emotions, and cultural values that are meaningful to the individual during the process of selecting, purchasing, interacting with, and using a product, service, or experience. A key characteristic of Human-CAS is the diversity and inclusivity of potential outcomes, which depend on the individual engaging with the designed artefact. Diverse cultural backgrounds and personal preferences therefore fundamentally influence aesthetic perception [29]. Consequently, Human-CAS are grounded in individual embodied perception and cognition. In conclusion, this definition postulates that human perception, emotion, movement, and cultural background co-construct aesthetic meaning. This here developed Human-CAS can be evaluated as valuable embodied social knowledge place, where aesthetic meaning is co-created through tactile experience visual-cognitive, and culturally symbolic processes and turning diversity into a strength.
At this point, a central question emerges: how can design education within VR-based learning environments enable students to embody aesthetic meaning without direct material contact? Donald Hoffman, a cognitive scientist and author of 'The Case Against Reality', refers to Darwin's theory of natural selection and argues that all living organisms, including humans, perceive reality through perceptual systems optimised for survival rather than for objective truth. He illustrates this by comparing different species' perceptual capabilities [30]. For example, bats perceive their environment primarily through echolocation, which enables efficient navigation and hunting in nocturnal conditions [31]. Dogs possess approximately between 125 and 300 million olfactory receptors, whereas humans have approximately five to six million, resulting in vastly different sensory priorities [32]. These examples illustrate that non-human species possess sensory capabilities that exceed human perception in specific domains. Consequently, humans are constrained in their sensory access to reality. This supports the assumption that humans do not perceive reality as it objectively is, but rather as it is functionally useful for survival in the individual's culture and environment.

4.2 Mental and Sensory Intelligence in Co-Ideating Spaces

Donald Hoffman's theory of perception, while contested within cognitive science, offers a speculative lens for rethinking material and tactile perception: as an adaptive interface rather than a direct representation of reality. Within the scope of this paper, the theory is not treated as empirical evidence, but as a conceptual provocation that allows reflection on how perceptual interfaces - such as virtual learning environments - might be intentionally designed to communicate cultural, traditional and tactile perception and meaning without replicating physical reality. One example of such an approach proposes virtual craft learning - in textile business aeras, such as learning to crochet, knit or sew through simulated exercises rather than through direct manipulation of physical tools, like proven (see chapter 2). Research on exergaming and mental rehearsal demonstrates that motor skills and cognitive performance can improve through movement-based virtual interaction and mental simulation [33]. While these findings cannot be directly equated with material-based craftsmanship, they provide indicative evidence that embodied learning processes can occur in the absence of traditional tools, thereby grounding in a base of information, mental preparation, and motivating further investigation into how aspects of craft learning might be supported through virtual environments.
Motivation and mental preparation, like it is proposed by Marina-Elena Wachs in her theory of 'Touching Material is Thinking About Material' [34], leads us to comparable improvements in physical and mental performances, that have been documented in individuals who engage in mental rehearsal of sports movements or musical performance. Neuroimaging studies demonstrate measurable neural adaptations and skill improvements resulting from purely mental practice and visualisation [35]. Motion-based and gesture-controlled applications thus provide precedents for learning through rhythm, movement, and virtual feedback [36]. This supports the assumption that craftsmanship skills in textile and tactile spaces can also be acquired through embodied interaction, even in the absence of physical tools and materials. That was shown by the sustainable analogue-virtual designed costume 'The Cry' (presented 12. Of June 2026, F. a M.) – see figures 2, 3. Another case study of cotton grass and the textile mind (see EPDE Conference September 2026) shows the didactically capability of envision sustainable design solutions by the combination of embodied experiences and digital diverse tool for a

textile change management and usage of textile diverse archives – through the 'untouchable textile learning spaces'.
In the development of such virtual learning environments for future design education, artificial intelligence can function as a key component of augmented tactile learning systems and lead to embodiment. Artificial intelligence, when critically designed and carefully implemented, has the potential to support adaptive learning environments that respond to individual sensory, cognitive, and cultural differences. In this sense, AI can function as an enabling technology for inclusive Human-Centred Aesthetic Systems and educational scenarios, rather than as an autonomous replacement for traditional craft knowledge or pedagogical expertise.

5 THE UN-/TOUCHABLE DIVERSE DESIGNING MODEL

The scoping concept formulates 'how digital and AI-driven simulations translate textile tactility into visual form to 'feel' through vision'. Our just in time applied courses draw a hybrid-disciplinary and diverse didactically design environment. Diverse case studies integrate the concept of an expanded material mind (2008) as an expanded 'textile mind (2026) – for an integrative, interactive hybrid design field that emphasises experiential learning, spatial exploration, and collaborative co-ideation rather than direct instruction; this is and will be integrated into current courses of XR-learning design spaces. The didactic model integrates generative parameters such as motivation, information systems, and interdisciplinary mediators - both physical and AI-based avatars. The concept frames the effect of 'untouchable' tactility:

1. The 'feeling-through-vision' creative element stimulates industrial innovation;
2. New hybrid 'co-ideation spaces' are simultaneously activated by users and craft designers;
3. Craft designers are educated beyond traditional pedagogical models;
4. The traditional 'material mind' takes an active role in co-designing digital textile knowledge;
5. Connected educational spaces represent future diverse material-creation system, the 'textile mind' as an important tool included.
6. Industry-user interactions establish virtual creation by co-ideation & diverse-creation scenarios.

Diversity through participation by education with diverse media results in creating new products which are considered as significant sustainable - as valuable in the user's sense. Within this conceptual vision, design students may increasingly be positioned as mediators between physical spaces and virtual material domains, assuming reflective roles in translating embodied, cultural, and Human-CAS across hybrid design contexts and diverse tactile designing and co-ideating spaces.

DECLARATION

AI – Usage only for evaluating our style of writings - not for developing content.

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