



DRS2020
BRISBANE, 11–14 AUG
SYNERGY



Studying Material Interactions to Facilitate a Sense of Being *with* the World

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doi: 10.21606/drs.2020.229

Abstract: Material interactions are fundamental to design and craft education; however, they might also provide opportunities to reflect on sustainable behaviour in general. In this paper, we present an interdisciplinary undergraduate course in which students interacted with clay and wool. By engaging novices in material-based craft processes, we examined renewed ways of experiencing the materials to reconsider our everyday material interactions and our dependency and responsibilities in regard to materials in general. Through this example, we discuss the potential of craft practice as an educational platform to discuss materiality and to facilitate a deeper and more holistic understanding of the consequences of our material behaviour beyond the creative practices. The students' reflections over the five weeks touched upon their renewed appreciation of materials, and their changed interactions with materials – moving towards a dialogical stance rather than only using them as a means to an end.

Keywords: design education, material exploration, interdisciplinary, novice makers

1. Introduction

The present environmental crisis indicates that we are not fully aware of the destructive extent of our material engagements. Understanding that we co-exist with our environment, animals and materials can change our thinking and behaviour from being destructive to becoming more inclusive and sustainable. In this study, we utilised craft practice as an educational platform to examine ways of engaging with and thinking about materials. Experiential knowledge of materials is built through personal engagement with material environments and material explorations (Groth, 2017; Aktaş, 2019; Nimkulrat, 2012). Reflecting on these experiences can also evoke a deeper understanding of human-material



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interactions in our everyday lives. Crafting requires co-operation between mind, hand and material (Sennett, 2013) that facilitates thinking while making (Ingold, 2013; Nimkulrat, 2012). Craft processes can, thus, illuminate material interactions more clearly and propose new ways to experience the materials.

Experiences emerging from material interactions shape our ways of thinking and behaving (Malafouris, 2013, p. 44). Therefore, we may perceive them as active factors in our everyday lives. Seeing material in a more active way has been studied to some extent within making processes, particularly to understand how they shape the emergence of an artefact through the intentions of the maker (Bolt, 2007; Ingold, 2010). Materials have also been studied to understand how the designer's decisions and the user's interactions can be interwoven through material qualities and the notion of *materials experience* (Karana, Pedgley & Rognoli, 2014).

In the present study, we examined the performativity of materials in the making processes and its contribution to new ways of interacting with them, not from a technical and solution-oriented viewpoint but from a reflective one, by studying personal experiences. Rather than working with professional craftspeople, we chose to work with university students who were mostly novice makers as we expected them to be sensitive to their new encounters. Thus, they could potentially reflect on making activities with a fresh lens that was not motivated by using the material as a means to an end.

The five-week-long *Human-Material Interaction* course familiarised students from multiple disciplines with the notions of material interaction from a theoretical, embodied, shared and societal point of view through lectures. In addition, the students concretised their theoretical learning through hands-on material ideation and experimentation.

The aim of the course was not to teach a new practice but a new way of experiencing the materials and to challenge established ways of thinking about materials. The hands-on materials experience was used as an educational tool for critical thinking by employing the materials as the main learning setting (as described also in Mäkelä & Löytönen, 2017, p. 254). As teachers, we initiated discussions about how our experiences are affected by materials and how our actions impact on our material surroundings. The empirical data used for this study consists of the reflective texts of eight of the 15 students in this course.

The analysis indicates that the bodily experiences of materials triggered a self-reflective process in which students challenged their established understandings of materials as inert instruments. Next, we present some theoretical views that underpin the study. Then we present the setting and the study, and finally, we discuss how studying material interaction through craft practice can generate critical questions about our everyday material engagements.

2. The role of the material in the process of making

In our everyday encounters, due to their different qualities, our experiences with materials affect how we feel, think or behave (Karana, Pedgley & Rognoli, 2015, p. 19). Political theorist Jane Bennett (2010) writes about material's power to affect us, and she calls this the *vitality of matter*. She argues that things and materials, or nonhumans in general, are vibrant, active, and creative since even when there is no contact with humans, materials continue transforming and making recognisable change (ibid. p.93). Thus, according to Bennett, the attentive power of things significantly shapes the world and affects human experiences (ibid. p. 93).

Design researchers Elvin Karana, Owain Pedgley and Valentino Rognoli (2015) also refer to the activeness of materials and how this continues even when the material is transformed into an artefact. They argue that "A material ages with its users, matures in time, carries the traces of one's life span, facilitates the recall of memories, and relates one to the familiar and usual" (ibid. p. 24). Focusing on the experience aspect of material engagement can significantly contribute to the meaningfulness of our material interactions. Understanding materials experience is important for designers and design students as through these, they can ideate and develop new products or user experiences (Karana, Barati, Rognoli, & Zeeuw van der Laan, 2015; Tung 2012; Mäkelä & Löytönen, 2017; Nimkulrat, 2010; Pedgley, 2019).

However, not only designers or craft practitioners interact with materials. Therefore, we find critically studying human-material interaction necessary to point to the urgent need for changing our behaviour with materials. A more attentive attitude towards material interaction may have the capacity to make a difference in our behaviour with the environment at large. Acknowledging this capacity can stimulate and provide a wider understanding of the lifespan of the material that is not limited to the direct engagement with products but also includes how the raw materials are obtained and what happens to them at various stages.

Crafting is a powerful platform to study material interaction since it conveys universal values contextualised locally through "social and cultural, economic and ecological settings" (Niedderer & Townsend, 2018, p. 196). Being local and universal at the same time enables craft-practitioners to start discussions based on personal experiences that are globally relevant (ibid.). Also, importantly, craft-making connects materials with body and mind through a dialogical relationship (Brink & Reddy, 2019; Sennett, 2013; Mäkelä, 2016). As anthropologist Tim Ingold (2010, p. 97) argues, while practitioners engage with materials, they follow the material properties to let the final artefact emerge. The maker travels *with* the material to *look with* it as the work unfolds (ibid.). While making, the maker is not expected to force a preconceived idea, but rather to collaborate with and listen to the voice of the material (Pallasmaa, 2009, p. 55).

In this dialogue, while making, we constantly follow the material's responses and re-evaluate our own intentions to accommodate the material's resistances and movements (Aktaş &

Mäkelä, 2019, p. 64; Pickering, 1993, p. 576). The resistances and challenges emerging from the materials are also needed for the development of the maker's skills (Pallasmaa, 2009, p. 63). As Ingold (2012, p. 434) states, a craft skill is gained through learning how materials behave and how to be with these material challenges. This interaction grows into larger meanings for craft, which acknowledges existing knowledge, while also going beyond them and presenting new modes of knowing (Barrett, 2007, p. 118).

Similarly, archaeologist Lambros Malafouris (2013, p. 9) argues that material engagement actively shapes and co-constitutes the ways we think within an extended dimension of the material surroundings. According to Malafouris (2013), thinking occurs between brains, bodies and things, and this process is affected by people, artefacts, time, and space (p. 67). Through the engagement between the material and the body "the world touches us" and we understand "how this world is perceived and classified" (Ibid. p. 60).

Therefore, as philosopher Mark Johnson (2007, p. 265) argues, through our bodily coupling or interacting with the material environment we also understand abstract concepts or the meanings of things. We can further these meanings by following the possibilities emerging from our bodily interactions, and how they propose new connections or relations (Ibid., p. 265).

Ingold (2013, p. 8, 110-111) proposes that we are always part of the surrounding and our personal knowledge grows from, around and between being in the world. He argues that knowing and learning should come from inside practice and should emerge through being *with* it (p.10). Similarly, we propose that understanding human material interaction can shift our perspective from being in the world to *being with the world*. Such intense engagement with materials encourages a dialogical rather than dominating relationship between self and the material (Brink & Reddy, 2019). Material engagement, thus, becomes a co-constitution of the material and the practitioner. This discussion is especially important when our knowledge about a certain material is limited, as in the case of novice practitioners, or because the material is recently developed (Niinimäki, Kääriäinen & Groth, 2018).

According to research on expertise, novice makers follow rules to produce an artefact in a context-dependent way (Dreyfus, 2004, p. 177). As they gain experience, they learn how to handle various tasks simultaneously, and later they are able to lean on their skills intuitively.

Struggling with material resistances and experiencing the complex conditions emerging from the struggle can change dominating knowledge types or behaviours (Haraway, 1991, p. 68). Our idea was that if novice makers construct their material knowledge from a dialogical perspective rather than through a set of rules for controlling the material, then their material relationship could develop freely. They could then reconsider their sense of ownership of the material and the process of creating the artefact, the latter moving from being a dominance-oriented one to a dialogical one. To further elaborate on these thoughts, in the next section, we will present the course design and learning outcomes.

3. The Human-Material Interaction Course

The course was offered through the University-Wide Art Studies (UWAS) platform at Aalto University that aims at engaging undergraduate students with arts-based transdisciplinary thinking. UWAS presents a wide selection of arts-based elective courses to challenge students' thinking and widen their perspectives across disciplinary boundaries. The idea is that by working in a diverse group and discussing problems from many angles, the students might be better equipped to build a common language and tackle complex problems and societal issues in the future.

To facilitate good discussions and to be able to handle the material processes and reflections of the students qualitatively, we set the maximum participants at 15 students. The course was conducted in spring 2019 with 15 students from the departments of electrical engineering, computer science, business, arts and design. Data from eight of these students has been analysed in this present study. Informed consent regarding their participation in this study, including consent to the use of images and data in publications, was gathered from all participants

Most of the students were novices, either in craft/design or to the material they used. Only one design student had been working with clay after primary school, the other students stated that their materials were new to them. As the course aimed at discussing materiality in creative making processes, we incorporated theoretical readings and lectures with hands-on craft making at the university's makerspaces and studios.

Each class was conducted in three parts: in the first part, the students discussed the course literature that they had read before the class, exchanging reflections on the readings that introduced that day's discussions on the topic of materiality and covered concepts such as experiential knowledge, material resistance and affordance, material agency and non-representational theories. This was followed by a 20 minute-lecture in which the teachers articulated the concepts further, connecting them to design and craft practices, and facilitated a discussion on students' interpretations of these ideas in relation to their own material processes.

The second part took place at the studios in which students worked independently but next to each other. Working at the studio provided a safe environment with peers around to exchange experiences and receive teacher-guidance when needed. Their making processes continued independently in their own time, which encouraged experimentation and provided freedom (Figure 1). After a couple of hours spent in the workshops, the group reassembled for a shorter reflection meeting in the lecture room to exchange their experiences.



Figure 1: Two students felting at the studio. Photo by Aktaş.

The students were free to choose their own materials, but we initially offered two materials to the students: clay for ceramics and wool for felting. These materials were selected since they were materials that the teachers have been working with in their research. Selecting materials that the teachers were competent in facilitated deeper conversations with the students. The students were given some demonstrations of the materials and also experienced the materials themselves by touching and manipulating them. Then they were asked to choose one of the materials to work with during the course. In the first two weeks, we encouraged the students to be explorative with the materials to understand their properties and aesthetic features. To deepen the discussions, the second author helped each student individually to throw clay on the potter's wheel while blindfolded. This exercise was designed to reduce the powerful impact of sight and let other senses experience the material (Groth, Mäkelä, Seitamaa-Hakkarainen, 2013).

The students were also asked to work with their material blindfolded sometimes to experience the material's haptic properties. Beginning with the third meeting, we encouraged the students to focus on one aspect of their material interactions and emphasise that experience or feature in their processes towards their final artefact. The students were also handed diary notebooks and encouraged to document their explorations and reflections as part of their making and thinking practice by taking notes, drawing and photographing (Figure 2). This was a new way of working for many of the science and business students, as were the studio-based material explorations and practices.

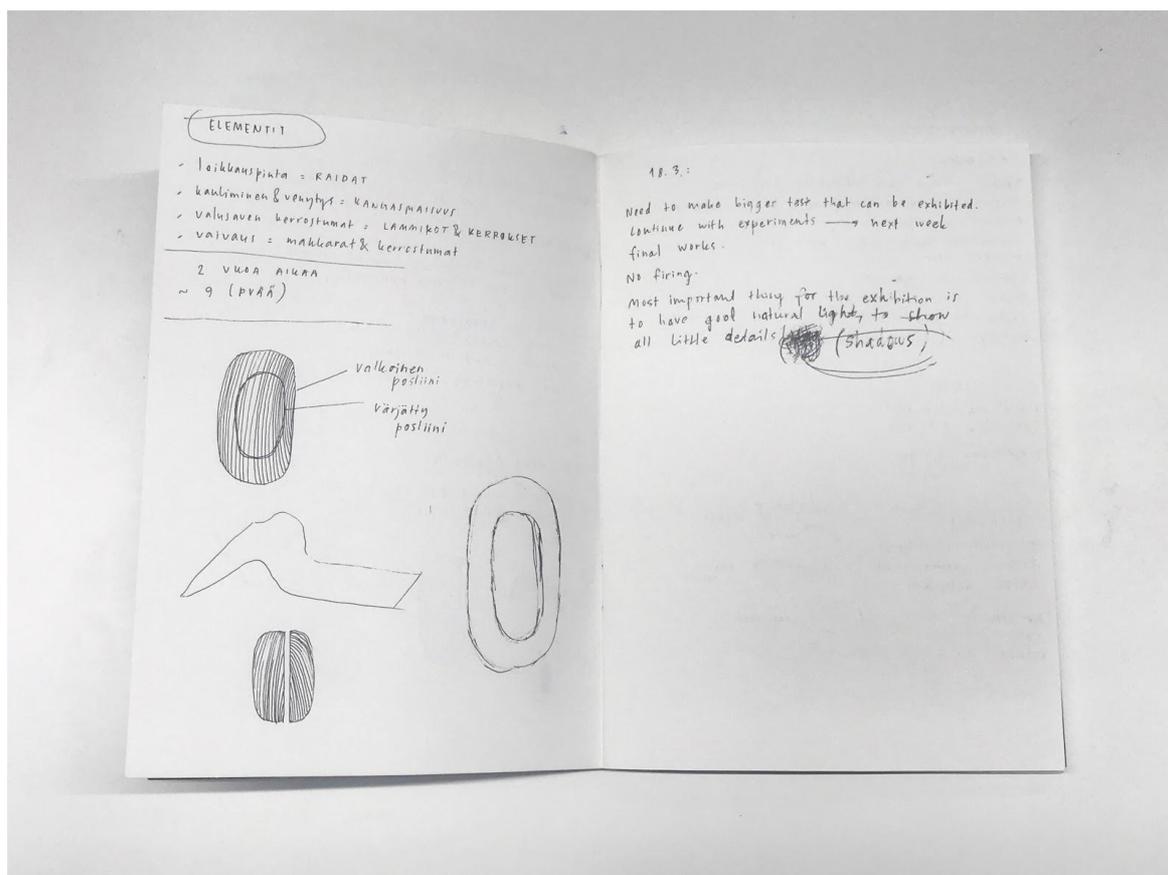


Figure 2: A reflective diary page depicting the textures of the material. Photo by Aktaş.

Our role as teachers, when in the workshops, was limited to being facilitators and to asking the students questions in order for them to articulate their thoughts. We started discussions and encouraged them to share their opinions and challenge the newly introduced concepts of the theoretical lectures.

Previously, other scholars that share similar ambitions also employed designerly methods, such as explorative making or reflective writing. Some also propose new methods, such as material-driven design (Karana, et.al. 2015), material-based design (Oxman, 2010), or DIY materials (Rognoli, Bianchini, Maffei & Karana, 2015). These approaches often seek new aesthetic experiences through material innovations by bringing design, science and technology together (Rognoli et.al. 2015). Although we used similar tools, our study differs from these examples as we do not aim to develop new materials or products in this course, but rather to generate a modus of experiencing and being *with* the world.

3.1 Explore, Adapt, Overcome

After working with the materials for five weeks and reflecting over material interaction in several ways and modalities, the students completed their final artefacts and prepared for the exhibition at the university gallery. They ideated the name and poster independently and

entitled their exhibition “Explore, Adapt, Overcome” to describe their creative processes (Figure 3).



Figure 3: On the opening day of the exhibition, the interdisciplinary student group presented their work to their course mates and their teachers in a crit typical for courses in creative subjects. Photo by Groth.

Some of the works presented were the outcomes of explorations rather than finished art pieces. We selected exhibition as a method of assessment to increase the sense of responsibility and community. Being part of a public event with their course mates also provided a dynamic exchange among the students. By exhibiting one’s work, the maker can see his/her work from the viewer’s standpoint while a viewer can see the work from the maker’s standpoint (Nimkulrat, 2010, p. 75). Thus, having a group exhibition provided a dynamic communication not only between students but also between the final works and the viewers. To facilitate such communication, the students prepared a final oral presentation and wrote a short reflective essay on their creative process and the artwork to be displayed next to the artefacts.

4. Reflections on the students’ processes

The final assignments and the reflective diaries during the course constituted the main empirical data of this study. The first author also conducted notes in the teaching sessions

while the students were discussing and reflecting over their experiences and the theoretical aspects of the course. We studied the students' texts through thematic analysis (Fereday & Muir-Cochrane, 2006), and after reading the texts several times we searched for places where mention was made of material engagement and reflections on material experiences.

To find this information, we coded repetitions, use of unique words, metaphors and transitions between different topics. Later, we grouped these codes as large themes to understand patterns in their thinking (Braun & Clarke, 2006). Identifying these themes for each student's text provided basis for seeing similarities and differences between their reflections (Ryan & Bernard, 2003). The key themes emerging from the texts revealed how the students developed their reflective and critical thinking in relation to their creative processes and prior knowledge. The analysis also highlighted how students make sense of their experiences (Braun & Clarke, 2006, 78; Fereday & Muir-Cochrane, 2006, p. 81).

Some key themes emerging from the texts were related to (i) getting to know the material and its behaviour from a new perspective, both with and without human presence, (ii) referring to previous knowledge and experiences to make connections, and (iii) referring to natural environments that they had encountered earlier, such as being on a beach. While identifying these themes, we found that bodily experiences emerging from the craft-making facilitated thinking beyond the crafting activities.

The students bonded various senses together, such as the smell of the material and the studio, hearing the sounds coming from the surrounding and the tools, with particular attention to their use of their hands. Their thinking emerged through their peers, tools, and studio space, or in Malafouris's (2013, p. 67) words, within people, things and space. Being open to these multidimensional experiences also required accepting their lack of skill as a new angle to discover the material's properties. The students elaborated on the material's properties, nature-related features, transformations, movements, and what the material seemed to demand from them. While making, they studied both the material itself and their own relation to the material in a dialogical manner.

These findings encourage us to speculate on how first-hand material experience provides an educational platform to challenge the current understanding of materials and material environments more dynamically and collaboratively. Studying the first author's observational notes that she had written down after each class meeting also supported this examination. In the next section, we will present some quotes from the students' texts to exemplify how they articulated their experiences of the materials.

4.1 The student reflections

Often, the reflections of the students sought for co-operation between them and the material. Being open to the voice of the material and their bodily interactions with the material started a new dialogue that pointed at a more holistic understanding of material engagement. The initial experiences in the course helped students understand the materials'

behaviour and how they could interact with them. One of the students examined the durability of the wool fibres, so he developed a form based on the properties of the materials.

“The black wool that was used to craft this piece was so fragile, it was easy to pull apart with little force. After wet felting ... the felt piece here is significantly sturdier than wool. This transformation had relatively little to do with me. Rather, it's an intricate property innate to the material that I tried my best to explore and showcase.” (a computer science student, Figure 4)¹.



Figure 4: A student's exploration of wool. Artefact presented in the student exhibition. Photo by: Aktaş.

The students also referred to how the tools and surrounding environment actively affected their experiences while interacting with the material. For several students, previous material

¹ The texts from reflective diaries were written in English by non-native speakers and they have been edited slightly for clarity.

experiences and prior knowledge played a significant role in how they interpreted the material's possibilities. This also enabled them to interpret the concept of material agency in their own ways. They also referred to their embodied knowledge of other practices and discussed them as part of their reflections on the readings and the material interactions:

“Embodied skills make me think of sports - in my case volleyball - ... it can happen that a player is rewarded as the most valuable player (MVP). This can make people – or even players – think that the MVP did it, he won the game, he scored the most points. But actually, it is the global situation that allows him to score those points. The opponents made the mistakes and lost the ball, the MVP's teammate gave him the perfect set, the teammate sitting on the bench encouraged him to make the MVP more confident, the light of the gym was perfectly fitting with the sensitivity of the MVP's eyes.” (reflection made by a business student).

Both in the final written assignments and in the reflective diaries, the students discussed their works in relation to their prior experiences by explaining what the *material experiences remind them of*. We interpret this as an attempt to make their experiences meaningful for the projects or interpret the abstract concepts in a way that is more personally relevant. This phenomenon also shows that the experience of the material is remembered and retriggered in the next similar encounter; thus, previous interactions can be revisited to find familiarity (Karana et.al. 2015).

As a result of experiencing the activeness of the material and the dynamism built around these interactions, some students questioned concepts, understandings, and approaches that are deeply embedded in creative fields. For instance, one student questioned the idea of functionality as this may be seen as solely human interest and how we can move from a function-oriented making process to an experience-oriented one. Another project, by a design student, focused on the aesthetics of the material as opposed to the aesthetics of the maker. She examined the use of tools and worked with the ways the tool marks left their presence on the artefact as an aesthetically valuable aspect instead of an error (Figure 5).



Figure 5: A design student worked with the clay to develop material-based textures and tool marks.
Photo by: Aktaş.

In her project, she reflected more on the responsiveness of the material and questioned the sense of controlling the processes. As teachers in the course, we connect this to the understanding that when makers articulate their practical and theoretical knowledge through iterative making, they transfer their understandings of abstract concepts to their artefacts, too (Pöllänen, 2009, p. 255; Johnson, 2007 p. 228). This was also visible in the student's final text and artefact:

“The main aim was to leave room for the material to show its features and emphasise the traces that are left during the process of making, either through hands or from the tools that are used. As a designer with a strong background in ceramics, the process of making is often tightly connected to the end results and the fulfilling of my own expectations. I have realised that these expectations can often restrict the creative process and set limitations on the maker and the material. Through this work, I wanted to avoid any expectations and purely focus on the process itself by making room for tactility, serendipity and movement.” (A design student, Figure 5).

Another interesting discussion that emerged from several students' reflections was taking on the idea of the material's life cycle. After experiencing the *vitality* of the material, the students started discussing what happens to the material when there is no human presence such as, how material generates its own patterns without humans or how clay cracks while drying overnight. For many of the students from fields other than the arts or design, these

were interesting experiences as they could concretely observe how materials make changes “on their own”. One computer science student reflected over the aftermath of the material:

“It’s obvious that humans don’t understand materials as well as they might think they do ... The extent of material produced by humans is hard to comprehend without seeing it, as is the permanence of inorganic man-made materials lying on landfills or floating in the ocean ... Think about how the material came to exist, how you will make use of it, and how and when it will eventually cease to exist.”

Overall, the students challenged themselves to truly understand what the material was like and what it could become. At the end of the course, the students’ idea of what and how a material can be was significantly broader than a means to an end. For example, a business student wrote:

“Materials are employed by us in order to produce something we need ... in this sense, the relationship between human and material is unidirectional and dominated by humans. This is the way I recognised materials before. Nevertheless, even the first touch of clay altered my mind. It was sticky and heavy but gave rise to a desire to knead and play (with) it. So, it has magic. The subsequent production process is the exploitation of its magic for me, in a way.”

The reflections indicate that the students were able to question their own perceptions of materiality in general, which were mostly built through societal understandings. Craft making became crucial in concretising abstract concepts and in making new personal interpretations of the material’s capacity as the students experienced the dialogical nature and dynamism of their material interactions. One student visualised this process by showing the cycle between feedback (thinking) and decision (making) within the material environment while throwing clay on a potter’s wheel (Figure 6).

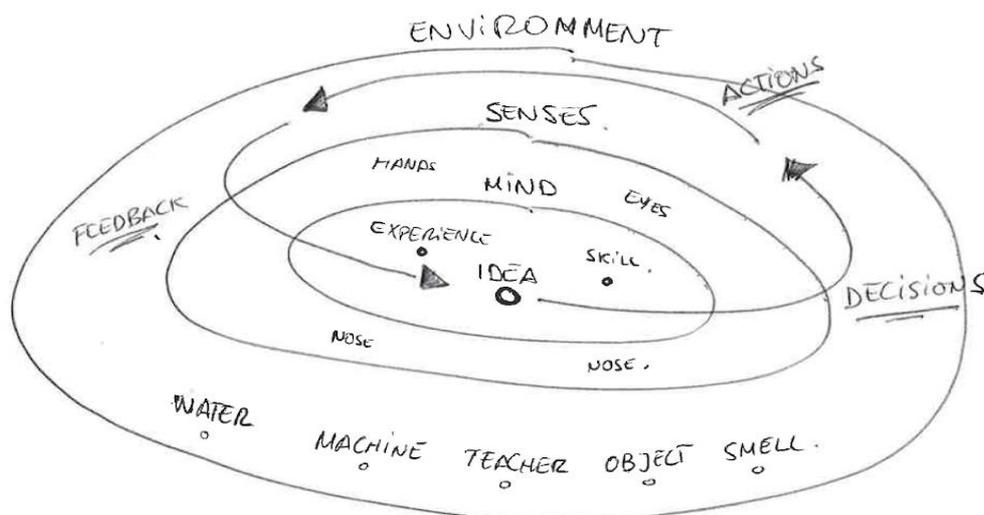


Figure 6: Visualisation of the material interaction by an electrical engineering student.

His drawing positions the responsiveness and dialogical nature of making in the centre and visualises how the surrounding elements come together in a sensible way. We believe that these material interactions helped students to position their actions in a wider context and understand the effects of other elements in their surroundings and how their own actions affect the environment. In the next section, we will discuss the potential of craft practice as an educational platform to discuss materiality and to widen the concept of sustainable material behaviour in contexts outside the creative practices.

5. Discussion

The final assignments and reflections indicate that for most students the process started with “losing control”. Several students referred to the importance of being open and attentive to the material features. Starting the course by blindfolded material explorations encouraged being with the material in a flexible and open-minded manner. Even when the students were frustrated at times because of the material resistance, they challenged themselves and continued working.

As the students documented their making sessions by writing and sketching in their diaries, they reflected on and articulated their thoughts, experiences and feelings further. Reflecting on craft making processes reveals the insider’s knowledge and how decisions are made during creative processes (Mäkelä & Nimkulrat, 2018; Groth, Mäkelä & Seitamaa-Hakkarainen, 2015). Reflections that emerge from craft making can inform both the practice and the theoretical understanding of the practice (Nimkulrat, 2012, p. 11). They also enable the reconstruction of the practice by reviewing processes and planning future material engagements (Aktaş, 2019). Thus, for the students, the documentation functioned both as a reflection on what they did and what they would do in the next session (Mäkelä & Nimkulrat, 2018, p. 12).

By using the craft experience to think about their material engagement, we encouraged students to also reconsider their other everyday material experiences. As the key themes that we identified from their texts suggested, students explored the materials, revisited their previous knowledge, and referred to their experiences of their natural environment to understand the material. These themes were later elaborated on in their material engagement, and the students reflected on the idea of controlling the material while interacting with it.

We found that first-hand material experiences facilitated a transition towards the sense of being *with* the world in five ways which emerged from the above themes. The reflections indicate that when the students employed an interactive way of working with the materials, they could understand their behaviour from a wider and more critical perspective, and follow the flow of the material rather than forcing through a preconceived idea (Bolt, 2007; Ingold, 2012; Pickering, 1993).

In this way, some students were ideating while making by employing material movements as a design element. Accordingly, the first-hand experiences enabled students to understand **how the materials behave and how to be with the materials**. In particular, starting the process through blind-folded working provided an invaluable experience for the students to “lose control” of the process and to become more open to material movements and their haptic sense.

Their journey included challenging their skills and established ways of thinking about material interaction, as well as developing the mental persistence to continue working *with* the material resistance rather than against it. Despite the frustration and intimidation of sometimes failing in their attempts, the students found their own ways to accommodate the material resistances (Pickering, 1993), by experimenting and perceiving making as a dialogue with the material (Mäkelä, 2016).

This process contributed to **critically re-considering human-material interaction**. By provocatively looking at the materials as active participants of our everyday lives, students gained a wider perspective on what materiality means and how much it impacts our thinking and being in the world. As argued earlier, to make sense of the world and understand our position in it, it is necessary to recognise that material engagements shape thinking and making (Malafouris, 2013, p. 44). In a sense, the students stayed with the material resistances to find different ways to be with the material and what to do with it. They, as makers, were no longer dominating but following the intuitive flow of material transformations.

To concretise the new conceptual knowledge and review their existing knowledge from a new perspective, the students referred to their previous experiences and personal knowledge. This indicates that we need **prior experiences to make sense of what we are experiencing today**. Our previous knowledge and skills facilitate making sense of new materials and finding ways to overcome challenges emerging from new materials (Groth & Mäkelä, 2016, p. 18). This also enables us to understand our past experiences in relation to new ones (Haraway, 1991; Fredriksen, 2011). In our study, reviewing prior knowledge also enabled students to find ways to develop their own interpretations and ways of interacting with the material.

At the end of the course, the students were using the word **material in a broader meaning**, referring to media, nature, and light as materials and actors in their projects. This also shifted the idea from one of using materials to one of working with them (Pallasmaa, 2009; Ingold, 2010). They also referred to their materials as a resource to learn a craft skill. In connection to the concept of experiential knowledge, students argued that listening to the *voice* of the materials can become a significant way to learn new knowledge, since “the material teaches the craftsman about its capabilities and limitations” (reflection by a computer science student), (See also Mäkelä & Löytönen, 2017).

As Bennett (2010, p. 12) proposes, we need to ontologically shift the ways we understand the material to overcome hierarchical social constructions. These constructions affect the ways we perceive the world, and the current situation indicates that this perception has been destructive. Thus, with this course, we aimed at starting a discussion on how we engage with materials and what other ways there might be than the normative.

We could observe that a shift in perspective was emerging from the course, and the students' material processes *re-conceptualised established human values* such as aesthetics or functionality. These re-conceptualisations offered to embrace the features emerging from the material as opposed to seeing them as failures, mistakes, or errors. This approach also questioned the idea of humans as owners of the materials and the world and instead emphasised co-existence and co-evolvement with it. Considering the growth in developing bio-based materials, most designers and makers will be novices in working with these materials. Thus, we need further studies to widen our perspective on material interactions that include environmental sustainability as well as ethics (see, for example, Niinimäki, Groth & Kääriäinen, 2019).

6. Conclusion

Our current ways of thinking about our interactions with materials are insufficient to understand the results of our actions. Often, our understanding of a material is limited to the engagement period, paying insufficient attention to how the material is before the interaction begins and after the interaction is completed.

By using craft practice as an educational platform in this study, the students engaged in reflections on material interactions and triggered critical thinking that could possibly also affect behavioural change. The thought-provoking concept of material agency, the notion of the "voice" of the material and a dialogical making process encouraged students to critically review their ways of engaging with their material surroundings.

A change in thinking about our relationship with the material environment begins on the personal level. Utilising first-hand experiences to understand human material interaction can become a powerful tool to better understand how we should interact with materials in a responsible and respectful way, realising that humans do not own or dictate but collaborate with materials. In our study, we observed a change in students' thinking and the benefit of having such an interdisciplinary group of students enlarged the scope of discussion beyond the individual and the specific disciplines.

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