Hands on

Mariam Syed
Master of Research 2022
Innovation School
Glasgow School of Art

Table of Contents

1 Introduction

2 Scope of Context

3 Methodology

4 Field Work

5 Discussion and Analysis

6 Conclusion

7 References

8 Appendix

<u>Abstract</u>

This research explores the relationship between a craftsperson and its digital tools in order to locate and understand the importance of tacit knowledge and craft experience in a craft-technology hybrid making practice. Much of the craftsperson's design decisions are dependent on tacit knowledge but tacit knowledge is not easily communicated to others. It must be learnt through osmosis rather than verbal instructions. This research affirms that it is tacit knowledge that empowers the craftsperson to apply intellectual thinking and material intelligence when making with digital technologies. By drawing on my own practice as a weaver, I aim to understand and expand on the role of the craftsperson at the intersection of craft and technology in the making of modern objects. The definition of craft and specifically craft as knowledge is crucial for this research. The positionality of digital technology in craft practices is explored through engaging with craftspeople with craft knowledge and craft-technology hybrid practices. This study also identifies the motivational factors, attitudes and perceptions of craftspeople for incorporating digital practices. The significance of this research is that it demonstrates a research methodology of drawing out tacit knowledge that can be replicated to further understand its role in the making of contemporary craft.

Acknowledgements

Declaration

I, Mariam Waqas Syed, declare that this submission of full thesis for the degree of Master of Research meets the regulations as stated in the course handbook.

I declare that this submission is my own work and has not been submitted for any other academic award.

Mariam Waqas Syed

The Glasgow School of Art, December 2022

<u>VOLUME 1</u>

This research occurred over two cycles—one that represents the scope of context, methodology, and participant fieldwork and discussion (Volume 1) and one cycle that reflects my work as a reflective practitioner (Volume 2). Therefore, included with each volume is a table of contents, lists of figures and terms, and instructions for reading each volume.

Prelude

I am a weaver. A weaver of silk scarves. A weaver of wool rugs. A weaver fascinated with the visual culture of my home city, Karachi. A weaver who believes her craft to be sacred. A weaver who is passionate about vibrant colour and geometry. A weaver who weaves on an electronic Dobby loom and yet struggles to understand the growing influence of digital technology in modern craft making. Approaching my craft with a spirituality akin to the weavers of lore, my making process is about finding the right balance between the heart, hand and mind. It is about placing more emphasis on the process rather than the final product.

Figure 1: Hanging Scarves by Mariam Syed (Author's own, 2022)

Figure 2: Empress market in Terracotta by Mariam Syed (Author's own, 2022)

Fascinated with the vibrant coloured Pakistani trucks set against the magnificent Colonial British Architecture of Karachi, I aim to narrate my cultural heritage as a story through my woven textiles. Pakistani trucks look like giant kaleidoscopes of brilliant colours and patterns; much like an art gallery on wheels! I love the explosion of pattern and pop colours on the trucks and picking out geometric patterns from the city buildings. I strive to achieve the same boldness of colour in my woven designs and balance the vivid colours with earthy tones of the buildings.

My making process begins by slowly and meticulously constructing weave structures on graph paper using the Double-cloth weave technique. The weave structures are derived from my drawings; which are black and white collages made from photographs of places and objects that inspire me. As a weaver, I see the world in geometric shapes and find it exciting to transfer my vision onto paper this way.

It is important for me to work monochromatically at this stage as the inclusion of colour distracts me from focusing on the patterns. Once the loom is dressed, I start weaving by responding intuitively to the warp and weft in the moment in time. The vibrancy and lustre of silk yarn reminds me of the beautiful colours of my childhood in Pakistan and I tend to use it regularly for my scarves. Spun from British reared sheep, the wool I work with is my small effort to pay homage to Britain; my home now. Weaving on an Electronic loom with 32 shafts allows me to weave complex patterns. Some may argue that an electronic loom is part of modern technology, but I see the electronic element of the loom as an added feature that enables me to play around with the permutations resulting in the design possibilities to grow enormously. It doesn't take the making process away from me. I am still very much in control of the weaving process.

The need for this research project arose from a trip to Xian and Chengdu, China in the spring of 2018. As part of the British Council Living Research Programme,

Figure 3: Pakistani Truck Art by Mariam Syed (Author's own, 2016)

*Figure 4: Weaving with colours from Pakistani Truck Art
(Author's own, 2023)*

alongside seven other makers, I travelled to China to investigate the maker culture in maker-spaces, craft hubs and design houses. The Chinese traditional craftspeople, acting as guardians of craft were determined to pass down their skills but the new generation was more interested in the newer technological crafts like robotics. The Chinese traditional craftspeople held onto their 'Intangible Cultural Heritage' certificates awarded by the United Nations with a fierce protectiveness and the younger generation showed immense promise in technology related activities that I conducted as part of the programme. Technology has made 'crafting' so efficient that the youngsters did not want to spend hours learning techniques by hand. The great divide I observed, suggested that a bridge between the two could unleash a new form of creativity and innovation that both generations and China could benefit from. The thought of the excellent craftsmanship of the Chinese craftspeople slowly dying down made me question and blame technology. Is it even worth the price?

Figure 5: Bamboo weaver in China (Author's own, 2018)

Figure 6: Chinese Shu embroiderer (Author's own, 2018)

Figure 7: Young Chinese children engrossed in a robotics workshop (Author's own, 2022)

Figure 8: Chinese Ceramists (Author's own, 2018)

Later in the year, I went on a study trip to Hala, a small village about 200 kilometers north of Karachi in Pakistan. Funded by the Jerwood Charity, I collaborated with the only hand weaver left in Hala to learn the traditional technique of Sussi-weaving that Hala has been famous for centuries. Sadly, the last hand weaver sustains himself through international funding and grants while the remaining weavers had started working in small factories on mechanised industrial looms. It could be argued that technology is to be blamed again for this transition and for robbing the next generation of weavers of quality hand skills.

Figure 9: Industrial loom in Hala (Author's own, 2022)

Figure 10: Maula Baksh, the only hand weaver in Hala (Author's own, 2018)

Figure 11: Industrial Looms in Hala, Pakistan (Author's own, 2018)

Figure 12: Shah Abdul Latif Bhittai shrine (Author's own, 2018)

When I talk about my reservations with digital technology, it is about the control I feel that digital fabrication tools take away from the maker. Another form of digital technology that I experienced was in a project called Distance 2. Aiming to offer Scottish makers the opportunity to experience, collaborate, and promote sustainable ways of making via immersive technology, 'Distance 2' was funded by Creative Scotland and delivered in partnership by Applied Arts Scotland and Soulis Heritage. For the project, I collaborated virtually with a glass artist from Aberdeenshire and a product designer from the Cairngorms to design an object in virtual reality and then transformed it into physical reality using each of our materials. While it was exciting to collaborate virtually, we were skeptical about its use in our practice. I gained new digital skills and a fresh perspective on my own design practice and learnt to successfully 'make' in a virtual environment curating a virtual exhibition of my individually crafted virtually objects. But do I see it as a useful tool in my everyday making? Perhaps not. While my virtual drawings were creative and exciting, I find them too ambitious to be translated into reality. I yearned for the physicality of my making process; of tactility and touching the materials in virtual reality. Hence virtual immersive technology is nothing more than a digital design tool for making outlandish sketches.

I want to continue asking questions about the relevance of digital technology; about the threat of technology to hand skills, the role of the modern craftsperson and the significance of tacit knowledge in utilising digital making tools. I began this journey of research to find answers to these questions and to reflect upon my design thinking and process. My reflections during the span of the Masters have been captured in diary notes and can be read in the Appendix sections 8.1 - 8.5.
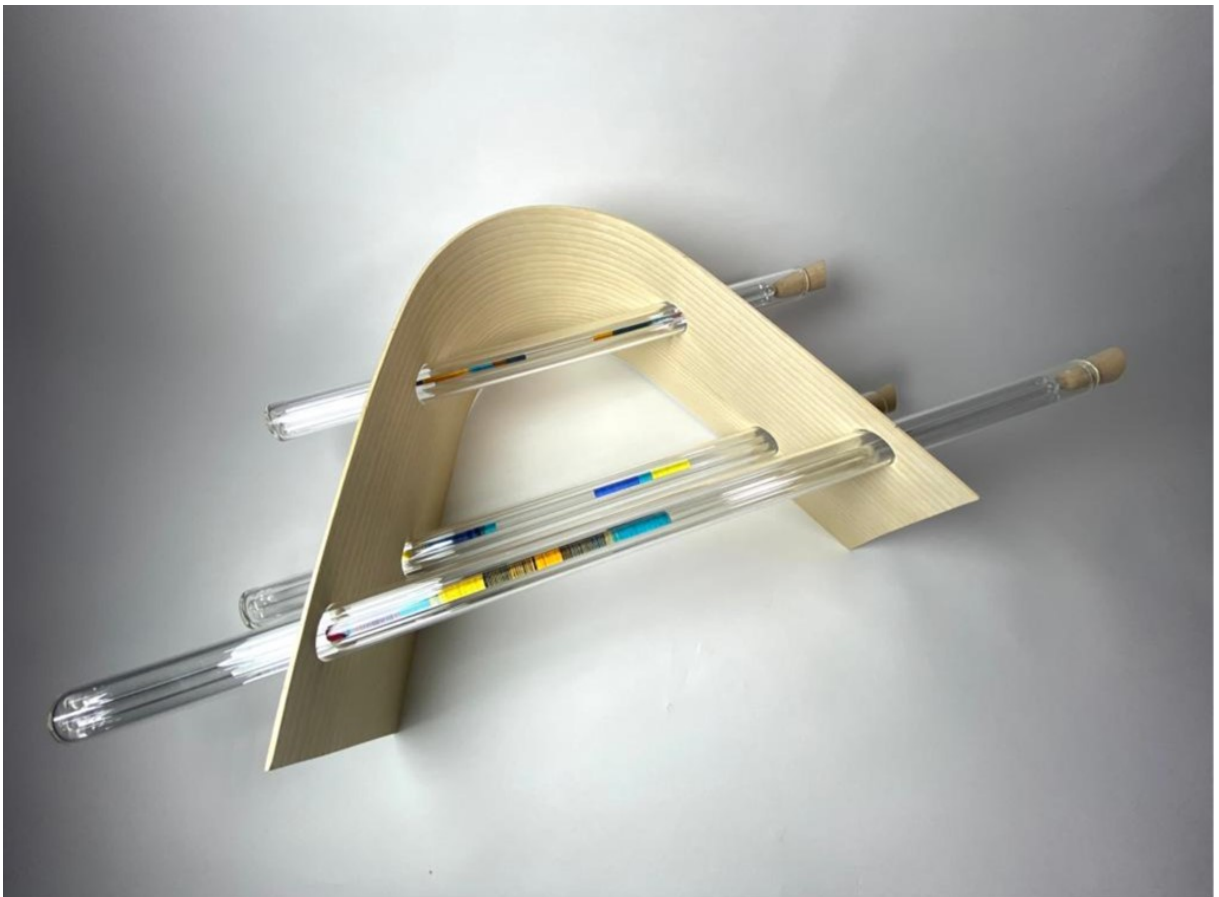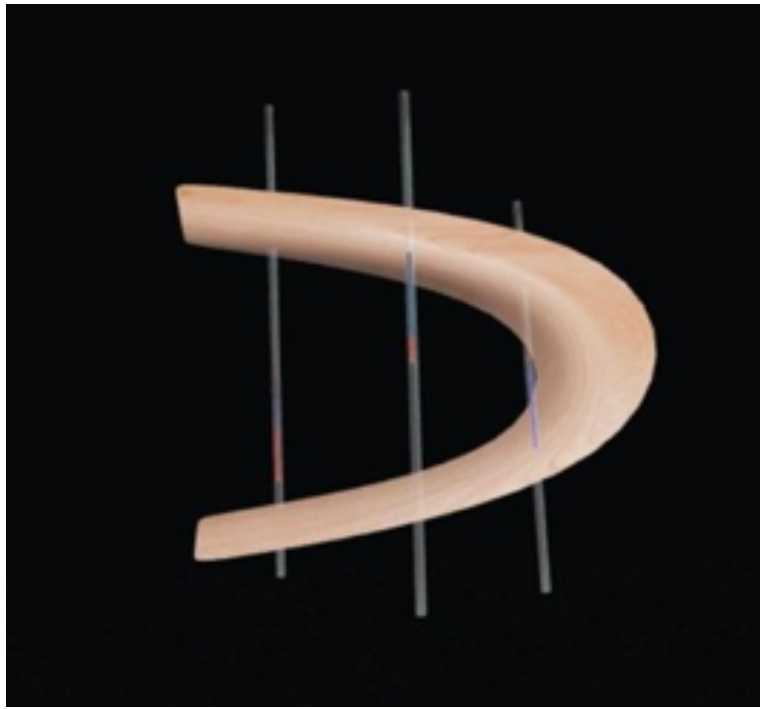
Figure 13: From virtual reality to physical reality: a collaborative object. (Author's own, 2022)
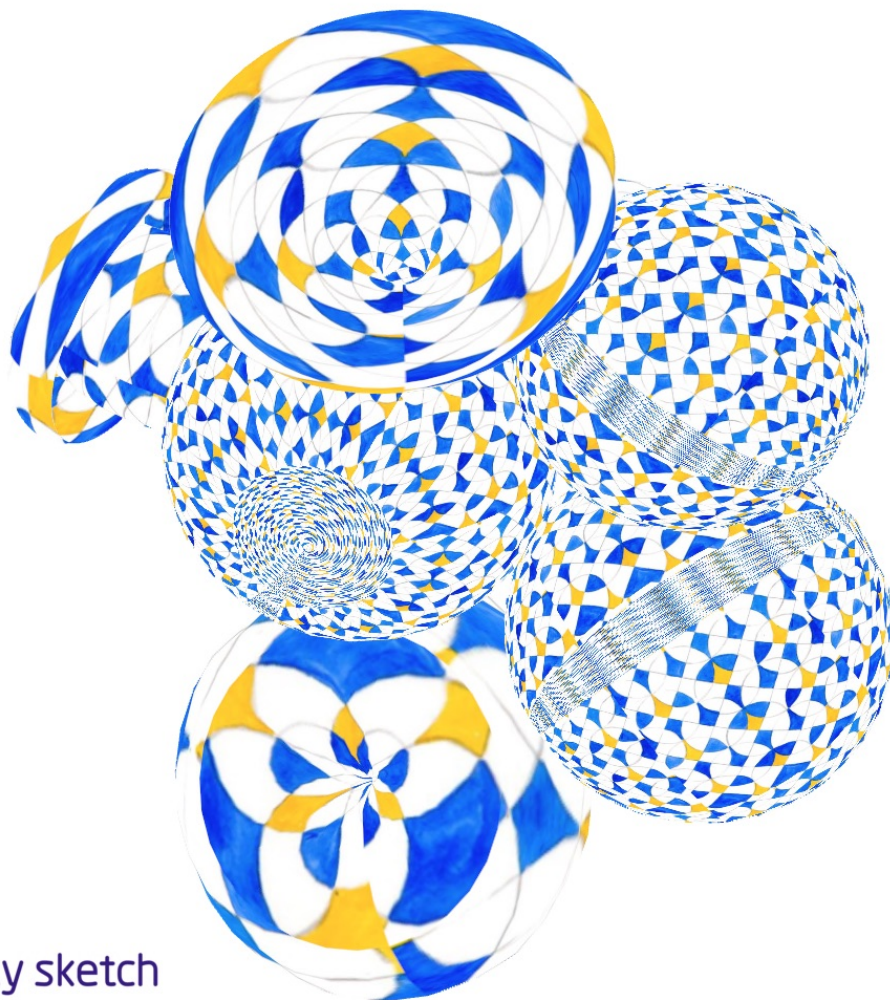
gravity sketch

Figure 14: Hand drawn to virtually created object. (Author's own, 2022)

GLOSSARY OF TERMS

CRAFT: a process of thinking instinctively and reflectively engaging with materials, techniques, ideas and responding to digital technologies.

HYBRID CRAFT: A craft practice that employs both traditional and digital technological tools and processes.

CRAFTSPERSON: A craftsperson is a person who practices craft. I have ensured that I use the gender-neutral term craftsperson to include both male and female craftspeople. However, the terms 'craftsman' and craftsmanship are used when directly quoting the words of other scholars.

TACIT KNOWLEDGE: Experiential knowledge that we know but cannot articulate in words

DIGITAL TECHNOLOGY in craft: an extension of the craftsperson's hand by combining traditional manufacturing methods with digitally produced materials.

ROLE: the function assumed, or part played by a person or thing in a particular situation.

WORKMANSHIP OF RISK: "workmanship using any kind of technique or apparatus, in which the quality of the result is not predetermined, but depends on the judgment, dexterity, and care which the maker exercises as he works" Pye (1968).

WORKMANSHIP OF CERTAINTY: an industrial and repeatable process in which the risk of the creation of the artifact is minimal, as a result of the implementation of high-end manufacturing technologies (Pye, 1968)

PRACTICE BASED ACTION RESEARCH (PBAR). PBAR is a form of self-reflective and reflexive practice that enables researchers to reflect on their own work; it is an inquiry that stems from the researcher's practice and involves the investigation of one's own practice to find the rationale for the decisions taken.

HAPTIC TECHNOLOGY: Haptic technology aims to recreate the sense of touch by transmitting tactile information using sensations like vibration and force via a haptic device that is an interface between the user and the computer.

List of Figures

1

Introduction

1.1 Introduction

This research is located within the context of digital technology in hybrid craft practices and is undertaken to understand the role of digital technology in craft where digital making techniques are combined with traditional craft making. In this chapter, I will lay out the overarching research question (1.2), aims and objectives (1.3), the audience for this research (1.4) and how to read the thesis (1.5).

Digital technology in craft practices is intriguing. It is efficient and saves time. It is also changing the way craftspeople approach making (Treadway, 2007). Craftspeople turn to digital technologies to innovate their craft; this union of tradition and technology yields exciting new aesthetics. Notably, the main reason for the success of the craftspeople with digital technology usage can be attributed to their craft and tacit knowledge that is acquired through experience and instinctively applied when crafting objects (Dormer, 1994; Shillito, 2022). This study aims to explore the importance of tacit knowledge and craft experience towards enabling craftspeople to realize the potential of digital tools and to use them to enhance their practice. The relevance of tacit knowledge in taking advantage of digital tools is investigated through practical experiments.
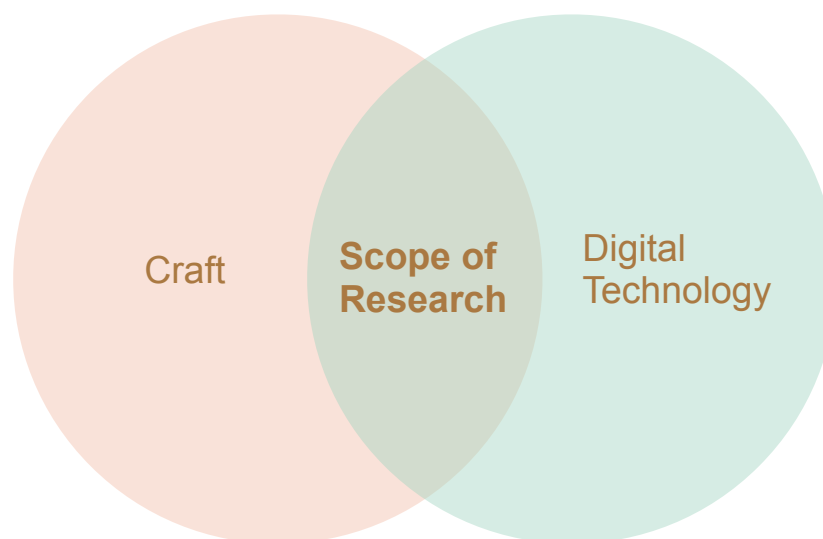
Figure 15: Scope of context (Author's own, 2022)

1.2 Research Question

The research question for this project has developed after gaining firsthand experience of digital technology in my practice. A new overarching research question emerged which is as follows:

Main question: What is the role of digital technology within craft and in what ways does it support and influence craft practices?

Sub question: What is the role of tacit knowledge in the utilization of digital technological tools in craft practices?

1.3 Aims and Objectives

The aims and objectives in order to answer the research question are as follows:

Aim 1: To explore the relationship between digital technology and craft practice

Objective 1: Analyse and evaluate the participant's reflections to identify how digital technology influences craft practices.

Aim 2: To determine the importance of tacit knowledge and practical experience of material processes and skills in the interaction of craft with digital technology

Objective 2: Design a task to engage with participants to draw out their insights and establish how tacit knowledge can be transformed.

1.4 The audience

This audience for this research is researchers looking to adopt a methodology to understand the importance of tacit knowledge and material skills in hybrid craft practices. Secondly, it is intended for craftspeople who are intrigued and apprehensive in equal measures of the use of digital technology in their making

practice. Through this research, I aspire to demonstrate how digital technology is just another tool; albeit a complicated one.

1.5 Reading the Thesis and Portfolio

The submission consist of two volumes; Volume 1 is the thesis and Volume 2 is the Portfolio of Practice. Volume 1 describes the theoretical research pertaining to the scope of context and methodological framework, as well as a discussion and analysis of the fieldwork carried out with the participants and ends with concluding remarks. Volume 2 is the Portfolio of Practice-based work that is a visual demonstration of the reflection-in-action, intuitive and iterative cycles of making as a response to the theoretical research. The Portfolio of Practice approaches the research through the lens of a craft practitioner and is a detailed account of the practice-based design process that evidences the role of digital technology in my practice as a weaver and demonstrates the importance of tacit knowledge when using digital tools. Both volumes support each other, are interlinked and can be read in parallel.

2

Scope of Context

2.1 Introduction

This research has been undertaken to gain an understanding of the role of digital technology in hybrid craft practices and to elaborate on the relevance of tacit knowledge and practical experience of material processes and skills in the interaction of craft with digital technology. This chapter presents the literature and contemporary examples elucidating the engagement of craftspeople with digital technological tools in their craft practices. For the purpose of this research, it is essential to establish a definition of craft. Dormer (1997), McCullough (1998) and Sennett (2008) set the foundations for this research while contemporary writers like Shiner (2007), Treadaway (2009), and Nimkulrat (2016) lend a critical voice on the subject. The definition of craft is explored in the first section and Pye's (1968) theory of workmanship of risk and workmanship of certainty is discussed to gain a better understanding of workmanship. The meaning of tacit knowledge and a craftsperson's tools are established in sections 2.3 and 2.4. Digital technology and the importance of tacit or embodied knowledge in the application of digital craft practices is explored in the final two sections.

2.2 Craft

Discussions around the nature and definition of craft have been discussed extensively both as a noun (skill) and a verb (process), creating a dichotomy between scholars and writers as the term is interwoven with art, design and industry (Song, 2021). Figure 16 displays the definition of craft by leading thinkers, writers and craftspeople. Craft, in the context of this research is defined as a process of thinking instinctively and reflectively engaging with materials, techniques, ideas (Sennett, 2008, Margetts, 2011) and responding to digital technologies (Schwarz and Yair, 2010).

Craft is an act of problem solving and analysing. It unites the body and mind (Sennet, 2008).
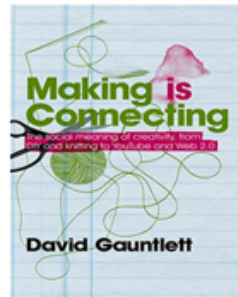
Craft creates connections (Gauntlett, 2011).

Craft is a form of making through hand manipulation (Nimkulrat 2010)

Craft's fate in modern times has been to manipulate and to be manipulated (Adamson, 2013)

Craft is organised around material experience (Adamson, 2007)

Craft is a union of imagination, facility and judgement in working with materials. (Pye, 1968)
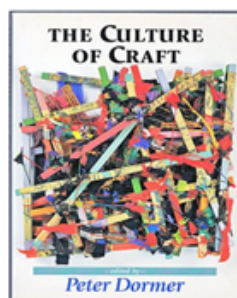
Craft is both the means through which the craftsperson explores the obsession or idea and an end in itself (Dormer, 1997).
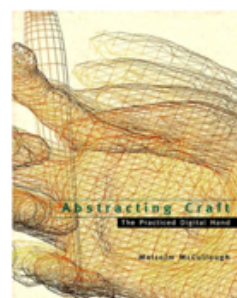
Craft is the application of tacit knowledge and skill applied towards practical ends (McCullough, 1998).

Figure 16: The definition of Craft by numerous scholars (Authors own)

A craftsperson thinks critically like a philosopher (Frayling, 2011), acts on intuition (Margetts, 2011), diagnoses and solves problems like a connoisseur (Dormer, 1995) and as a scientist knows the properties of its materials (Pye, 1968). Spilling (2019) poetically posits that a craftsperson is an inquisitive being who approaches making as a spiritual fulfilment. Nimkulrat (2016) claims that the most important quality of a good craftsperson is their relationship with their materials and tools. Dormer (1997) agrees and proposes that the engagement with materials can be either done by hand or controlled through the hand with analog and digital tools. The hand is a prominent attribute of craft and if reduced in engagement with tools or removed entirely leads to an object that cannot be considered as craft, writes Adamson (2010). Sharyn Dunn reflecting on the engagement of the hand in her craft agrees with Adamson's statement and likens an object produced with digital technology tools and a lack of personal human touch to the manufacturing done by robots in an interview with M. Mcewan (Mcewan and Scott, 2019). David Pye (1968) argues that it is not relevant whether an object is made by hand but the type of workmanship involved in the making. Pye puts forth the theory of 'workmanship of risk' and 'workmanship of certainty' that has influenced scholars interested in the discourse between craft and technology. Pye's coined phrases are discussed in the next section.

2.3 Workmanship of risk and workmanship or certainty

Pye (1968) warns that craft is "a word to start an argument with" and deliberately uses the word workmanship instead as it encompasses objects made with tools, both mechanic and manual (Dormer, 1997). The phrase 'workmanship of risk' and 'workmanship of certainty' and their meanings are detailed in figure 17 and address the tension between hand and machine or manual and mechanised (Adamson, 2007). It compares the 'ugly perfection' of identical clones to the unique hand-crafted objects that evidence the variable marks of the human hand (Shiner, 2007).

Workmanship of risk, according to Pye is unpredictable and fallible in contrast to the controlled nature of workmanship of certainty (Ryan and Macbeth, 2016).

Workmanship of risk	Workmanship of certainty
Individual production	Mass or serial production
Risky	Definite
Produced by a skilled person	Produced by a system
Carries the 'human mark'. No two objects are exactly the same.	Exact replicas can be produced once the design is finalised (after planning, testing and prototyping)
Diverse and unique	Predetermined
Unpredictable	Predictable outcome and quality
The object can be ruined at any stage owing to the maker's dexterity, judgement and care	Controlled
Every object is a new beginning	Continuation of one beginning
Variable	Consistent

Figure 17: Definition of Pye's workmanship of risk and workmanship of certainty (Author's own, 2022)

Workmanship of certainty considerably reduces risk and the learning-through-failure experience which is invaluable in craft development (Woolley & Huddleston, 2016, page 92). Dormer (1997) evaluates Pye's workmanship or risk and workmanship of certainty as a debate between personal know-how (tacit knowledge) and distributed knowledge. Mcewan and Scott (2019) explain that 'Distributed knowledge is acquired through the culmination of various techniques from different makers. It encompasses the idea that we are also able to use tools that require no previous personal knowledge. In addition, it is the possession of this knowledge and the way it is controlled that defines craft, rather than the attention on hand or skill'.

In contrast, tacit knowledge is essentially a technical grounding of   materials, processes and skills that is imperative in the production of meaningful craft and for realising the potential of tools, especially digital tools in the age of ever-advancing technology (Ryall & Macbeth, 2016, page 88). Tacit Knowledge is discussed in the next section.

2.4 Tacit knowledge

Polanyi (1964) is regarded as the pioneer of the concept of tacit knowledge which is debated and discussed in relation to craft by numerous scholars and thinkers. Figure 18 is a display of key words attributed to Tacit Knowledge by key writers and craftspeople. Pye explains that tacit knowledge is what we know but cannot express or articulate in words. It is embodied knowledge that craftspeople develop over time by physically working with materials and processes (McCullough, 1998).

Learned over a period of time (McCullough, 1998)	Experiential	Second nature, habitual and unacknowledged (Nimkulrat, 2016)
	Intangible	
Distinctive (Dormer, 1995)	Tacit Knowledge	Difficult to articulate in words (Polanyi, 1965)
Hand and mind works instinctively together (Shiner, 2007)	Hidden	Absorbed through osmosis by observing a master (Shillito)
	Personal	

Figure 18: The attributes of Tacit knowledge (Author's own, 2022)

Sennett (2008) declares that it takes ten thousand laborious hours of practice for a craftsperson to learn to intuitively respond to their materials and thus attain craft or tacit knowledge that includes our problems, hunches, skills, use of tools among many other unexplainable things (Shillito, 2013). Tacit Knowledge cannot be learnt from a book. Nor can it be taught. It can only be acquired by observing and shadowing who practices it (Adamson, 2018, Dormer 1997). Press (2007) states that craft and/or tacit knowledge is too significant and unique to be limited to crafts made with hand and

analog tools only but should be extended to making with digital technology. Tacit knowledge humanises technology as Dormer (1997) posits:

'It is not craft as handcraft that defines contemporary craftsmanship; it is craft as knowledge that empowers a maker to take charge of technology' (Dormer, 1997).

The above quote by Dormer forms the foundation on which this research is built. This study aims to demonstrate how tacit knowledge can enhance crafting with digital tools by creating a digital craft methodology that can be applied to further hybridised craft practices. McCullough (1998) adds to Dormer's quote that the combination of tacit knowledge and expertise with technology produces innovative outcomes. Craft practitioners are experts in the workmanship of risk and applying their tacit knowledge to materials, processes and tools both analog and digital (Alfoldy & Press, 2007). This union of tacit knowledge in the application of making with digital technological tools places more value and relevance to the definition of craft (Mcewan and Scott, 2019). Tools of the craftsperson are discussed in the following section.

2.5 Tools

Shillito's interviews of craftspeople with a hybridised craft and digital practice reveal that they view digital technology as a tool.

"A tool is a moving entity whose use is initiated and actively guided by a human being, for whom it acts as an extension, toward a specific purpose."

(McCullough, 1968, page 68)

Verbruggen of Studio Unfold is a strong advocate of craftsperson's creating and modifying their own tools (Verbruggen, 2014). He states that a traditional craftsperson was never happy with the shop bought tools and always customized it

according to their needs. Verbruggen writes that the role of the craftsperson in today's digitized times is to do the same with digital technology. Verbruggen is believed to be the first craftsperson to modify a 3D printer to print ceramics. The concept of personalizing tools; of being fascinated of the untested possibilities and frustrated with its limitations are discussed extensively by Sennett in his book, The Craftsman (2008). It is the interaction with the tool be it analog or digital and the creative mindset that determines the creation of innovative craft (Ryall & Macbeth, 2016, page 78). Digital technology is discussed in the following section.

2.6 Digital Technology

The common view of the application of digital technology in craft practices has evolved in the last few years (Alfoldy & Jönsson, 2007). Craft is forever evolving and reinventing itself; Adamson (2013) and Crook (2009) advise that craft should be analysed alongside modern technologies rather than in opposition as it is one and the same. Frayling (2011) believes that all twenty-first century craftspeople must learn the contemporary language of digital technology. Shillito (2013) in her book Digital Crafts, introduces digital making tools as innovative opportunities and lists them as computer-aided drawing and designing (CAD), visualization, 3D modelling and digital fabrication tools for example 3D printer, laser/water cutters, digital printing and computer numerical controlled (CNC) milling. Shillito assures the novice reader that digital technology making tools are an extension of the craftsperson's hand and an efficient addition to their repertoire. Adamson (2013) agrees. However, Sennett (2008) warns that digital technology though essentially a tool can either be a friendly tool or an enemy that steals and replaces handicraft. Shillito (2013) acknowledges that digital technology can at first be daunting as craft is primarily about staying in control of the making process and digital technology shifts that balance. The critical ingredient therefore is the knowledge that one brings to the table (Dormer, 1997). In

this manner, digital technology accelerates the craft process (Nimkulrat et al., 2016) and as a tool can be used to materialise the dreams, concepts and ideas of designers and craftspeople with greater precision to produce objects that cannot be made with the hand and analog tools (Treadaway, 2009).

However, a small number of craftspeople are apprehensive of digital technology and fear it is responsible for slowly diminishing the importance of hand skills (Treadaway, 2009) handmade, craft and tacit knowledge (Ottwell, 2010, Bolton, 2016). Townsend writes that the capability and accessibility of digital technology may lead to it being misused by many (Nimkulrat et al., 2016). Nimkulrat and Bakker (2018) are concerned about the absence of aura of a craftsperson's hand or touch in a digitally produced object. Nimkulrat (2016) adds that the distance craftspeople have from their digital tools and physical materials affects the spontaneous creativity and intuition of making by hand. The irregularity and fallibility element of handmade craft is sometimes missing from a digitally crafted object (Mcewan and Scott, 2019). Treadaway (2007) reasons that the flatness of colour and the craftsperson's lack of connection and ownership to the digital object can be rectified by recreating Pye's 'workmanship of risk' environment and to treat digital technology as a tool and medium for crafting like suggested by McCullough (1996) and many others. The distinction laid out by Pye in workmanship (workmanship of risk and workmanship of certainty) is crucial here as workmanship of certainty considerably reduces risk and the learning-through-failure experience which is invaluable in craft development (Woolley & Huddleston, 2016, page 92). A different perspective by Kourteva & Mc Meel, (2017) is that the mistakes that arise from digital technological tools can lead to 'dynamic' discoveries that Ruskin talked about when he urged his students to surrender control of their tools (Sennett, 2009). Marcus (2016) has been programming mistakes and imperfections into machines for his research producing

marks that are 'cumulative and contingent' to mimic the irregularities of the human-hand. Another example is Jenny Smith who developed a new collection of textile art from manipulating mistakes that arose from the laser cutter (Shillito, 2013).

Julia Ibbini also strives to mimic human-making by introducing flaws in digital designs to achieve the same human quality of irregularities and mistakes. Ibbini comments that her intricate laser cut art pieces designed in collaboration with Stéphane Noyer, are a celebration of an effective craft-technology hybridity which is organic and has imperfection that comes from her hand (Ibbini and Noyer, 2017). Digital technology, Ibbini believes, enables her to push the boundaries and limitations of her practice. She advises craftspeople to approach digital tools in a 'designerly way of knowing' as opposed to the scientific 'scholarly way of knowing' (Nigel, 1982) to maintain their creative signature, originality and enable workmanship of risk. This craft minded approach to craft and digital technology draws upon the tacit knowledge that craftspeople possess and is discussed in the following section.
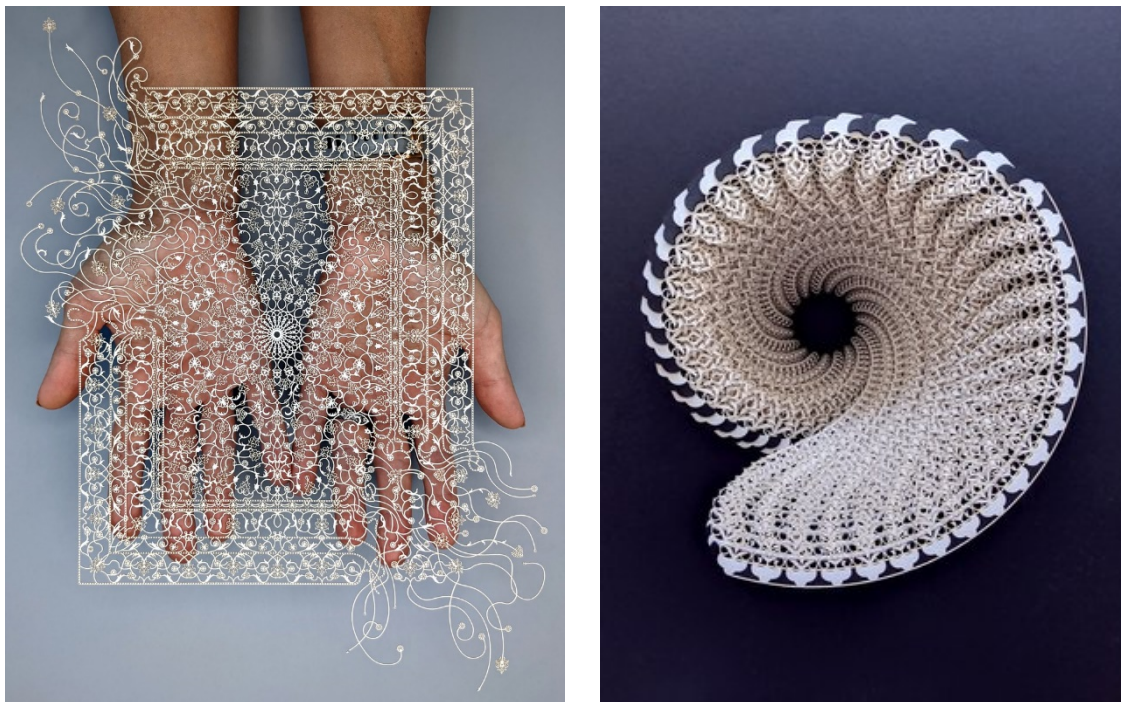
Figure 19: Intricate Pieces by Ibbini Studio(Ibbini Studio, 2021)

2.7 Digital Technology and Tacit Knowledge

Shiner (2007) questions whether the integration of craft and tacit knowledge with digital technologies is necessary for the production of craft but the human element of tacit knowledge cannot be easily ignored in the development of a hybridised craft-digital technology practice (McCullogh, 1998). Arguably the main reason for the success of the craftspeople with digital technology usage can be attributed to their craft and tacit knowledge (McCullough, 1998). Braddock (1994) discusses the innovation of textiles and gives examples of craftspeople like Reiko Sudo of Nuno Textiles who revive, modify and combine their tacit knowledge of traditional weaving techniques with technology to create innovative fabrics. The application of tacit knowledge and the understanding of materials has led to the invention of smart materials like quick-drying yarns, water-absorbing yarns and alternative fabrics (Braddock et al., 1994). Neal French, a ceramicist (1997), reinforces the importance of tacit knowledge with technology. Based on his experience and experimental conclusions, French posits that in order to manipulate the potential of digital technological software in ceramics, a craftsperson needs to be able to manipulate the physical potential of clay which comes from tacit knowledge of the hand and eye (Dormer & French, 1997). Another example is 'Signatures Exchanged for Passwords,' a series of textile artworks by Donna Rumble-Smith exploring the lack of physicality in communicating through emails (Nimkulrat, 2016 page 40). Transcribing hand-written notes into embroidery with great thought and care on her domestic machine, Rumble'Smith intuitively responded to the materials and techniques in the moment of time. Upon getting a commission to create a large-scale installation, she realised that she would have to work digitally on a multi-head embroidery machine to speed up the process. Rumble-Smooth was wary that the digital aspect would result in a perfect artwork deprived of the human touch or workmanship of risk. However,

Rumble-Smith's extensive knowledge of processes and experience of working with materials led her to make informed choices in selecting threads, stitches, fabrics and techniques to produce textile artwork with a craft aesthetic and one that she was pleased with. Candy and Edmond (2002) contradict this notion of the importance of tacit knowledge by stating that a novice craftsperson with no tacit knowledge of skills and materials brings cultural awareness that leads to questioning and thinking in new ways, alternative approaches and outcomes. While scholars and writers have passed statements on the integration of traditional knowledge with advanced technologies for generating innovative hybrid outcomes, not much practical research has been done in this area.

2.8 Summary

Within this scope of context, a definition of craft has been established as a process and a skill that involves engagement with materials and tools both analog and digital. The significance of tacit knowledge and craft experience are imperative in asserting a vital relevance and value of craft in today's digitised times. The literature suggests that digital technologies provide opportunities and possibilities beyond the capabilities of the human hand to the craftsperson who is in charge of realising its potential and for adapting it to its full capacity. Despite the vast literature and examples of craft practices with a craft-technology hybridity, I have identified a gap in knowledge of practice based research in digital craft practices and of the importance of tacit knowledge that empowers the practitioner to make informed decisions and bring a workmanship of risk approach to making with digital tools. This research aims to respond to that gap by investigating the role of digital technology within hybrid craft-digital technology practices and the role of tacit knowledge of practitioners that enables and enhances the effective use of digital tools. The following chapter will detail the research design framework and methodological positioning of this research.

3

Methodology

3.1 Introduction

This research is undertaken to understand the role of digital technology in hybrid practices where digital making techniques are combined with traditional craft making. This study aims to explore the importance of tacit knowledge and craft experience towards enabling craftspeople to take charge of digital technology in their making practices. This chapter will present the epistemology, theoretical perspective, the research design and methodological orientation of this research. It will also lay out the methods employed to collect data, the mode of analysis and ethics.

3.2 Digital technology: A Social Constructivist Epistemology

For this research study, craft practitioners were intentionally selected from varied craft backgrounds such as ceramics, jewellery, textiles and mixed media with hybridised craft and digital making practice so they could provide different insights into the role of digital technology in their craft based on their set of skills, craft know-how and tacit knowledge. Tacit knowledge (section 2.4) is a key element of this research and the subjective knowledge is derived from the tacit knowledge that the craft practitioners have developed over years of working in their respective craft fields and the application of this knowledge in engagement with digital tools. As each craft practitioner recruited for this study approaches and views digital technology through their own unique lens of skill, materials, knowledge and experience, this study is situated under the social constructivist paradigm. Social constructionism proposes the construction of meaning and knowledge through social interactions of humans with each other and their environment (Andrews, 2012). It implies that the knowledge constructed by humans is unique as it is profoundly influenced by culture and language which suggests that different meanings can be interpreted of the same phenomena by different people (Saleem, Kausar and Deeba, 2021). The tacit knowledge embedded in the craftspeople is important for the purpose of this

research and cannot be explained through measurable facts as done in a Positivist epistemology. The theoretical perspective underpinning this research will be explained in the next section.

3.3 Theoretical Perspective: Interpretivism

Establishing the focus of the study to interpret and understand the growing role of digital technology as a tool, the craft practitioner's perceptions, motivation and experiences needed to be analysed to respond to the research question(s), directing the theoretical perspective towards interpretivism. The interpretivist approach allows the researcher to capture the participants backgrounds and experiences in detail by adopting qualitative methods, for example, open-ended questions in discussions and interviews (Alharahsheh, 2020). Interpretivism was developed in opposition to the generalised, quantitative and factual nature of Positivism to understand the social lifeworld through constructing meaning from participant's lived-in experiences (Crotty, 1998). This approach is relevant to this research as the participants experiences with digital technology in their craft practices form the data for this study and the data is analysed by listening, interpreting and consolidating common themes to explain the importance of tacit knowledge of craftspeople that enables them to take charge of digital technology. The role of practice and the role of the researcher and tacit knowledge is detailed in the following sections.

3.4 The role of the Practice

Candy (2006) contends that practice-based research is an original inquiry to contribute to knowledge with the support of the researcher's practice and the outcomes of that practice (Volume 2). For this research study, I have placed my craft of weaving and knowledge of craft as the foundation on which this research has been built. Weaving is an intuitive act for me; it is instinctive, learned and it involves

responding to materials and processes in the moment of time. The decisions I make while weaving come naturally to me; my expertise is tacit and has been acquired over two decades of weaving in Pakistan and Scotland. The tacit nature of this expertise makes it difficult to be orally articulated but can be used to provide insights and solve problems (Polanyi, 1983). Tacit knowledge is deeply embedded in the making practice of all practitioners and it is the invisible thread that binds this research together.

Research that is framed in relation to the researcher's practice and expertise is fundamental in developing the methodology (Malins & Gray, 1995) because the creative practice underpins the research question(s). The need for this research arose from my creative practice, has evolved through the practice and has generated a better understanding based on the practice, which is detailed in the portfolio of practice (Volume 2). The theoretical thinking and creative making is not separate in this research study; it is a back and forth reflective process (McNiff, 2022) where I observe, plan, act, reflect in an iterative cyclic nature.

3.5 Role of the Researcher

Approaching research with two different hats of a researcher and a practitioner has limitations as well as opportunities (Hall and Earley, 2019). As a weaver, I observed and found a pressing question that I aimed to understand through my practice. Writing about her own PhD research experience, Joyce Yee states that she found combining her creative making skills of a designer with her critical thinking skills of a researcher beneficial in generating relevant insights and a better understanding of her research topic (Vaughan, page 162, 2019). Yee's stance resonates with this research because physically engaging with materials and digital technologies as a reflective practitioner as a means to understand the research context and critically

think and question my decisions has enabled me to construct meaningful insights as a researcher. Returning to my practice to reflect and answer the overarching research question required merging of the intuitive process of creativity with the critical systematic reasoning of research. The limitation or challenge of practice-based research was to recognise pre-conceived biases of the practitioner from the research inquiry in order to learn from the participants and to provide an accurate account of the findings.

The methodology and the methods devised for fieldwork are detailed in the following sections.

3.6 Methodology: Practice Based Action Research

Using my practice as a vehicle to explore the research topic by actively engaging with the design task of the third phase of the fieldwork (4.5), knowledge was constructed from the outcome of my practice (Volume 2 section 3.1, 4.11 and 6). The methodology for this research is Practice Based Action Research (PBAR). PBAR is a form of self-reflective and reflexive practice (figure 20) that enables researchers to reflect on their own work; it is an inquiry that stems from the researcher's practice and involves the investigation of one's own practice to find the rationale for the decisions taken. In so doing, I will work *with* (rather than study) other participants experiences and behaviours in using digital technological making tools alongside finding meaning and developing a new understanding from my practice (Bradbury and Reason, 2003). Working with participants gives the researcher the ability to constantly reflect and use findings to improve practice in craft. This method of research has more influence in shaping the research as a practice relative to other methods like grounded theory. Grounded Theory was also considered a possible methodological stance for this research, but grounded theory places more emphasis

on the participants who decide the actions whereas PBAR stems from the researcher's practice and is responsive to the emerging insights and therefore more relevant to this study.

Figure 20: Practice based Action Research Model (Author's own, 2022)

The research methods (see section 3.8) have evolved in a continuing cyclical nature with a back and forth motion from planning to implementing methods and then reflecting on the data gathered before planning for the next phase. This cyclic nature acts like self-evaluation and is a key element of an Action Research methodology. Accordingly, the research context and question(s) were iterated as the research journey unfolded. The impact of PBAR approach is that it equally benefits the researcher and the participants by allowing them to reflect on their practice and make sense of what they do and why. As this research has developed in an iterative cyclic nature of research, action and reflection, Participatory Action Research (PAR) was taken into consideration. However, PAR involves the researcher and the participants to work collaboratively to understand a problem and devise solutions that result in liberating participants (Walker, 1993) which is not the case for this research. The participants did not have equal weightage in designing the research methods and or in the analysis of the data. In the next section, the framework for recruiting participants is described.

3.7 Recruitment

The recruitment of the participants was an exploratory process and a response to opportunities and conversations in the initial phase of the study. All participants (figure 21) belong to different disciplines, have a hybrid craft and digital technology making practice and have differing motivations for using digital technology in their practices. Based in the UK, they possessed craft and tacit knowledge prior working with digital tools. Meera, a jewellery designer trained in India, was selected because she uses digital technology only for the part of her making process that cannot be achieved by hand or analog tools. Rumi, an interdisciplinary artist, teacher and technician, is knowledgeable about traditional making techniques as well as machines and digital technology. Rumi's fascination with digital technology as an enabler and his curiosity of pushing the boundaries of digital-making is the reason of his recruitment. Tara 3D prints jewellery, has written a book on Digital Crafts and is currently developing a 3D modelling programme at an affordable price for makers. Tara was recruited for this study because she strongly recommends makers to acquire craft skills and tacit knowledge before resorting to digital tools as an easy option. Describing herself as a process junkie, Nellie is a knitwear designer for women in the summer and a printmaker and glass worker in winter. During scoping conversations, Nellie claimed that the 'head' is as important as the 'hand' in making and a maker does not need to physically engage with the materials to produce 'craft'. Skye, a weaver who designs on Photoshop and then sends her designs to be woven in a mill was recruited because although her practice is more digital, she yearns for the physicality and tactility of weaving on a loom. Fleur, a ceramicist of over thirty years described digital tools as 'time-consuming' during our scoping conversations and was selected for this research because she struggles to understand the growing need for digital tools indicating that digital technology is challenging for some makers.

Meera, Rumi, Nellie and Fleur were recruited for the final phase of the fieldwork to broaden the understanding of craft knowledge that allows the craftsperson to take control of digital technology making techniques. The sample size of six for the second phase and then four for the final phase of the research gave a diverse representation across age, gender, craft practice and skills.

Knowing the participants before this research study is a limitation of this research (figure 22). The limitation of this participant sample is that it may not be a random sample, but this limitation has been managed since the participants belong to different craft specialisation making the sample representative.

Participant	How I know them
Meera	Worked in partnership on project Talaash
Rumi	Technician at a Makerspace that I worked at
Tara	Fellow team member of Project Distance
Nellie	Fellow Team member of Project Distance
Skye	QEST scholar
Fleur	Facilitated a project I worked on

Figure 22: How I know the participants (Author's own, 2022)

The methods and mode of analysis are discussed in the following sections.

Participants	Self-identification	Educational Background	About/ Projects	Reason for being selected for this research
Meera	Jewellery Designer Maker	• Bachelors in Accessory Design • Masters in Jewellery and Silversmithing	• Trained in India and specialised in fine jewellery with gold and diamonds to make props for historic period films in India • Passionate about sustainable, ethically responsible design practice	• Combines traditional jewellery making techniques with digital technology • Wants to use digital tools only as an extension of the hand for part of the design process.
Rumi	Technician/ Maker	• BA(Hons) in Design & Applied Art • MA Art & Design • PGCE Post Compulsory Education • MA Education	• Built a Bio-gun that 3D prints bio materials • 3D printed a prosthetic hand for a student • Digitally manipulated long exposure photographs of ballerinas and then transferred them onto glass which was cut with a water-jet cutter, folded and put in a kiln • Ambition to 3D print garments	• Wealth of knowledge • Curious about ancient making methods and new digital technologies in equal measure • Willing to share his knowledge • Passionate about his work
Tara	Maverick Maker	• Diploma in Art and Design • Master of Design, Royal College of Art	• 3D prints jewellery with non precious materials • Researcher of Haptic technology • Writer of Digital Crafts • Designer maker • Research Fellow at Edinburgh College of Art investigating haptics for 3D modelling	• Passionate about digital technology methods • Interest in Tacit Knowledge • Experienced maker of over 30 years
Nellie	Process Junkie	• Trained and worked as a criminal lawyer • Degree in Textile Design	• Knitwear designer for women in summer • Printmaker and glass artist in winter • Spinner • Dyer • Lithography	• Interesting insights on hand skills vs digital technology debate • 'My head is the biggest part of my making' • 'Making by head rather than by hand'
Skye	Woven Textile Designer	• Bachelors in Textile Design, Chealsea College of Art and Design • Masters of Design, Royal College of Art	• Works with merino wool and recently with recycled cotton • Describes herself as a 'messy and slow weaver' • Business orientated • Worries that customers will think of her as a 'fraud' for using digital technology for part of her design process	• Turned to Digital making methods to sustain her business • Yearns to hand weave again • Has craft Knowledge
Fleur	Ceramicist	• Bachelors in Ceramics	• Experience of working in ceramics for over 30 years • works with black and white porcelain • Hand-made tiles • Press molding • Passionate about a sustainable design practice	• Finds joy in hand making • Has worked with digital making tools but feels frustrated with them

Figure 21: Participant description (Author's own, 2022)

3.8 Methods

This research developed over three phases with five methods that are illustrated in the figure 23. The methods are explained in detail in the following sections.
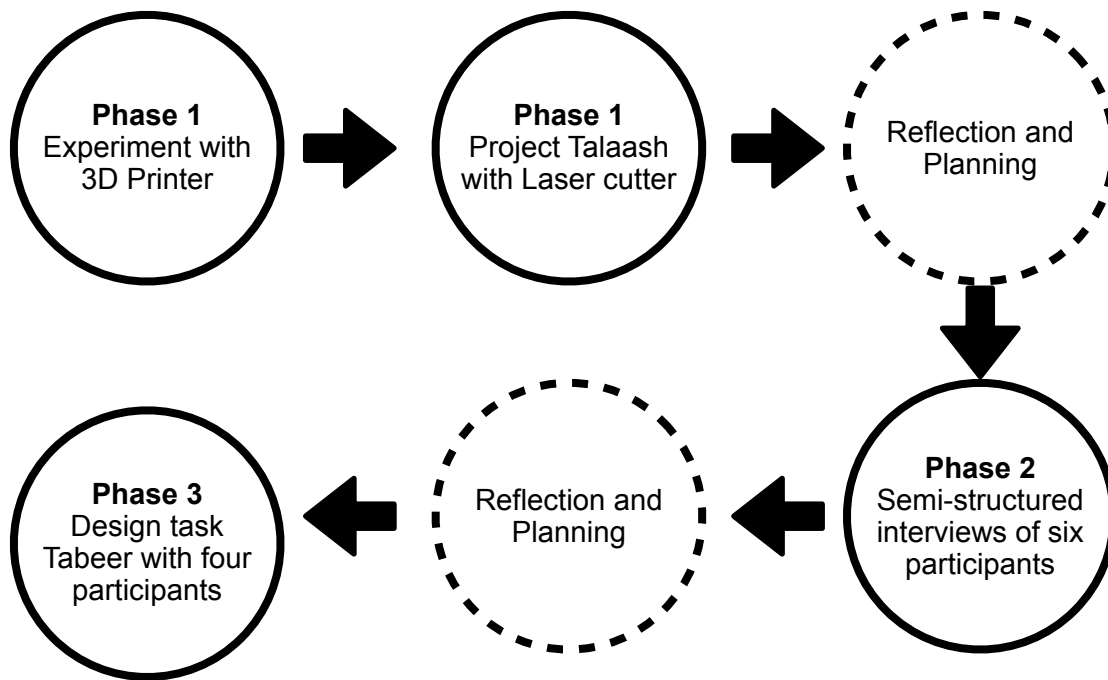
Figure 23: Methods (Author's own, 2022)

3.8.1 Phase 1

Experiment with 3D printers

To understand what digital technology means in craft practices, an experiment involving four 3D printers was devised. Bolt (2004, 2010), posits humans understand the world through practical handling of materials, tools and processes rather than by theorising the topic. This understanding develops tacit knowledge that is instrumental in this research. Building on Heidegger's handability concept, Bolt stresses the importance of material thinking or tacit knowledge in research and design. Drawing inspiration from Bolt, a needle was designed in a 3D software and sent at the same time to four 3D printers sitting next to each other on a long table. The aim of this experiment was to establish baseline knowledge of a digital fabrication tool and in

this case the capability and efficiency of a 3D printer and to test whether exact copies can be printed with a single digital file like in workmanship of certainty (Pye, 1968). The limitation of this method is that the experiment was carried out in one maker space and the result cannot be generalised by four instances. However, the emerging insights led to refinement of the topic guide for the interviews in phase two.

Figure 24: The 3D printer on top and the 3D printed needles on the bottom (Author's own, 2022)

3.8.2 Phase 1

Talaash: Experiment with laser cutter

The second experiment of the first phase comprised of a project titled Talaash in partnership with Tusheeta David, a Jewellerer. Talaash was based on the concept of imperfections that is found in hand made artefacts and explored whether digital technology possesses the attributes of Pye's (1968) workmanship of risk or workmanship of certainty. Variations of a pattern were designed, and a variety of weights and textures of fabrics were laser cut to understand the mechanics of a laser cutter. This experiment led the enquiry to seek the motivations of craftspeople amplifying their practice with digital technology to gain insights into the role of digital technology in craft. Talaash evolved my perspective, surfaced and abated my misconceptions and biases around digital technology and helped me to devise the next phase of the research fieldwork.

Figure 25: Two examples of laser cut fabrics from Project Talaash (Author's own, 2022)

3.8.3 Phase 2

Semi-structured interviews

With the aim of understanding the motivations of craft practitioners to engage with digital technological tools in their craft practices, six semi-structured interviews were planned with craftspeople with a hybrid craft and digital technology practice to gain an insight into the relationship of a craftsperson with its digital tools and to analyse practice-based knowledge through the capturing of lived experience. The rationale for using a semi-structured format with open ended questions was to allow the participants to lead the conversation to capture tacit knowledge embedded in the craft practitioners (McIntosh and Morse, 2015). The participants were all asked the same questions with slight variations depending on the trajectory of the conversation which helped in comparison of the common themes emerging at the time of analysis (McIntosh and Morse, 2015). The interviews were transcribed, and the commonalities mapped. Connecting with the participants digitally on Zoom allowed digital technology to become a 'tool' for research implying the growing use of digital technology in all fields. The remote nature of the fieldwork not only allowed an inclusion of participants from different geographical locations but also ensured that the participants could interact comfortably from their own workspace. The final phase of the fieldwork and the method is detailed below.

3.8.4 Phase 3

Tabeer: Design Kit

Emerging insights from the semi structured interviews revealed tacit knowledge and craft experience as common themes emerging from the data. The final method 'Tabeer: Design task' was devised to broaden an understanding of the craft and tacit

knowledge that craftspeople possess that enables them to take control of digital technology. An Islamic Geometric pattern was designed and sent digitally to Meera, Rumi, Nellie and Fleur to interpret, rework and craft using their own materials and digital processes, allowing the participants to independently interpret the pattern using their unique tacit and craft knowledge. Islamic Geometric Patterns were used because they are complex and require a high level of dexterity to be made into a physical object. The Islamic Patterns are usually drawn on a grid and have the potential for alterations and modifications that allow craft practitioners room for interpreting the pattern. Anecdotally, another reason for using an Islamic Geometric Pattern is that Islamic Artists are believed by some scholars to make a tiny flaw in the pattern to signify that only Allah is perfect and humans are prone to making mistakes.
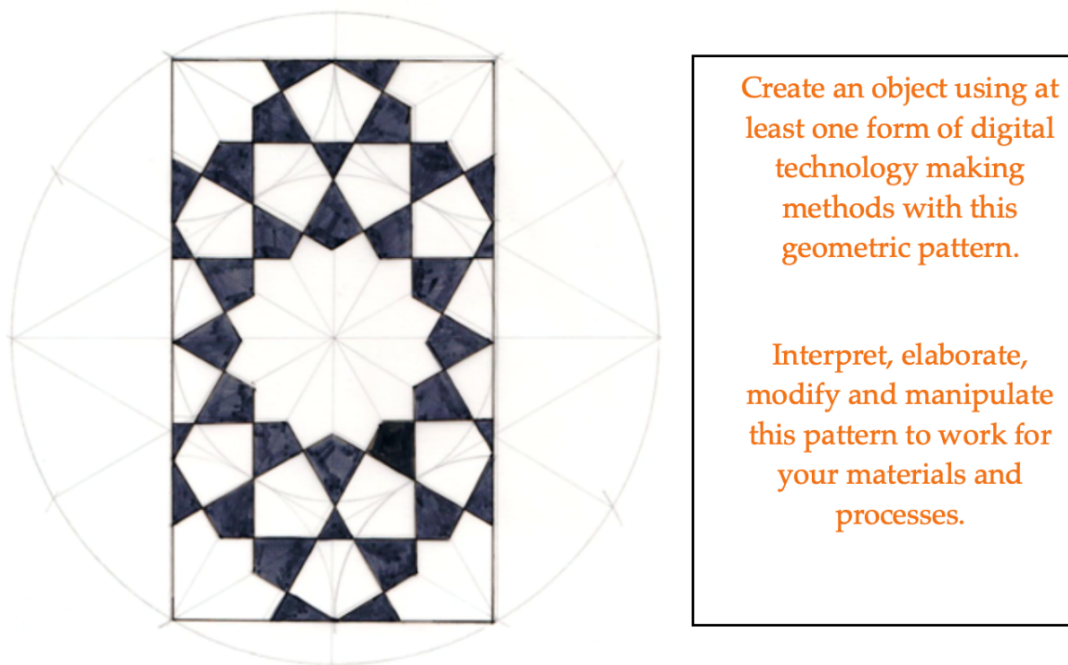

Figure 26: Tabeer: design task sent to four participants for phase three (Author's own, 2022)

3.8.5 Limitations

No cultural misappropriation will result by incorporating an Islamic Pattern in Tabeer as the purpose of the pattern is to be used as an inspiration for the practitioners for the design process. Islamic artists today come from a variety of cultural backgrounds and ethnicities. The Islamic pattern is a representation of the perfection and complexity of nature and nature is appreciated universally. The limitation of my natural affiliation with Islamic Geometric Patterns as they are a part of my cultural and religious background is acknowledged.

3.8.6 Phase 3

Reflective Practitioner

A reflective practitioner actively engages with physical materials, tools and technologies in its making practice to facilitate and develop the thinking and creative process to arrive at better understandings (Candy, 2020). Participating actively in Tabeer, I devised an elaborate practical experiment to determine the role of digital technology in my craft practice which is detailed in the Portfolio of practice. The experiment was to test out the themes of efficiency, capabilities, enhancement and possibilities that had emerged from the participant's interviews. By weaving on four different looms I aimed to seek how digital technology acts as an enhancer, enabler and expands my capabilities in weaving. As a reflective practitioner and in accordance with the PBAR model, a reflection-in-action approach (Schon, 1983) was decided to reflect on the process simultaneously with the making. The in-action element meant that I was continually aware of the process, taking notes, questioning my choice of materials and weave structures and evolving the process as I moved from one loom to the next.

The mode of analysis is detailed in the following section.

3.9 Thematic Analysis

A qualitative thematic analysis framework was employed to construct subjective knowledge of each craftsperson's experience and interaction with digital making tools and processes. The methodology of data collection was through action research which involves action, evaluation and reflection. This links directly to the theory of social constructivism where a social group constructs thing for one another collaboratively. The use of digital technology is the common denominator here which each participant uses in their craft specialisation. The use of technology gives a shared meaning to each interview participant.
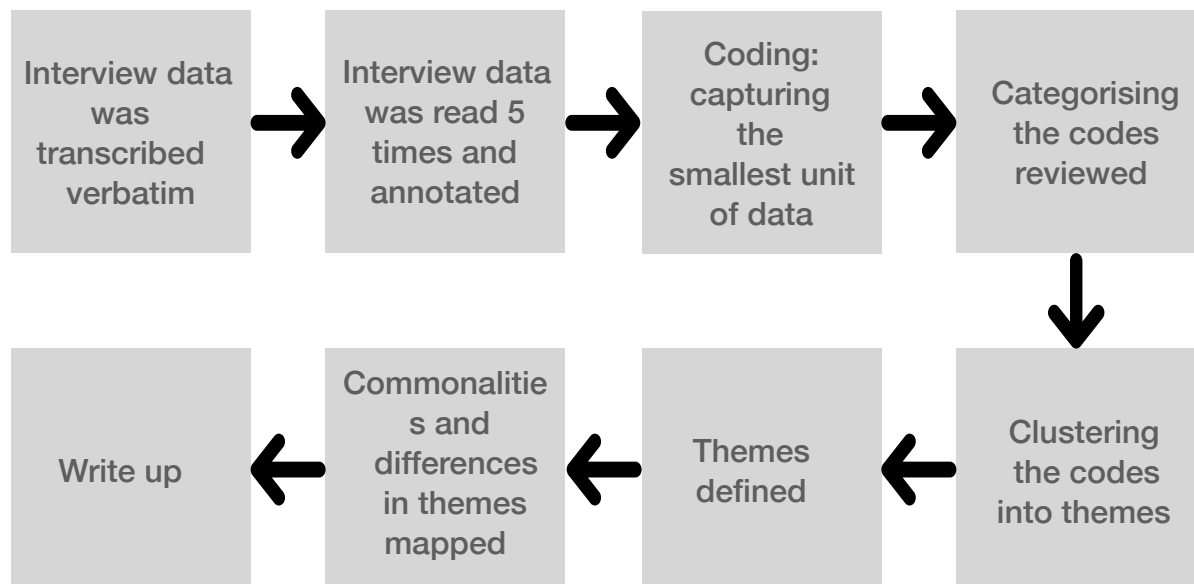
Interview data was transcribed verbatim	→	Interview data was read 5 times and annotated	→	Coding: capturing the smallest unit of data	→	Categorising the codes reviewed

Write up	←	Commonalities and differences in themes mapped	←	Themes defined	←	Clustering the codes into themes

Figure 27: Thematic Analysis of the research data (Author's own, 2022)

Braun and Clark's (2006) six-phase guide was elaborated upon to form the steps of analysis (figure 27). The needles from the first method were visually analysed by the researcher to assess the regularities in their appearance. The data collected from the interviews was transcribed, annotated and the reflections of the participant's experiences noted. A structure of coding is useful in making tacit knowledge explicit (Petrelli, 2017). Relevant and interesting codes were generated which were consolidated to identify themes and patterns as well as difference of opinions in the

58

data set. The themes identified were visualised and conceptualised (Holliday, 2002) and presented as diagrams to put forth as the connective thread in the discussion chapter. The initial interview data analysis indicated a need to reiterate the research question (figure 28). Thematic Analysis is relevant because it allows the research question to evolve as coding and themes are developed from the data. As this research study seeks to gain a better understanding of Tacit Knowledge in working with digital tools, TA is an ideal method that enables the researcher to identify codes and themes in relation to the participant's motivations, perceptions and experiences. Some limitations might be the longer period of time required for each participant to understand the use of technology (in the case of Fleur) and apply it to their specialisation.
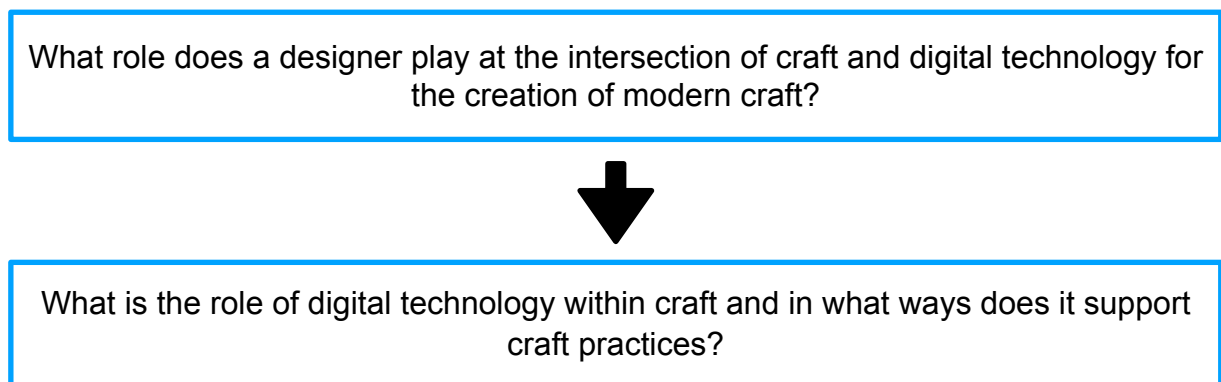
What role does a designer play at the intersection of craft and digital technology for the creation of modern craft?

⬇

What is the role of digital technology within craft and in what ways does it support craft practices?

Figure 28: The iteration of the research question (Authors own, 2022)

3.10 Ethics

Aligning the research project to the Glasgow School of Art's Research Ethics Code of Practice and Research Ethics Policy (2016), the participants of the study were provided with information detailing the research question and aims so that they could give an informed consent. The guidance from GSA's Ethics department was sought before embarking on the fieldwork. All the phases of the fieldwork took place remotely over zoom. The confidentiality of the participants has been ensured and the data collected will be securely stored. In accordance with GSA's General Data

59

Protection Regulation (GDPR) policy, the participant data will be destroyed within one year of the completion of the project. A copy of the information sheet and consent form has been included in the appendices for reference.

3.11 Summary

In this Methodology Chapter, the theoretical and methodological positioning of this research project has been laid out. The epistemology of this research has been established as social constructivism and the theoretical perspective as Interpretivism. The methodology, PBAR was designed keeping my craft practice as a key element of this research. The PBAR methodology enabled me to iterate the research process in a cyclic nature as the findings were unearthed in each of the method phases. The methods employed for this study are experiments with digital fabrication tools; semi-structured interviews; and sending a design task 'Tabeer' to four craftspeople and a digital technological making process. The data gathered is analysed using a thematic analysis framework.

4

Field Work

4.1 Introduction

This chapter elaborates the phases of fieldwork for this research inquiry. For the first phase, two experiments with two digital fabrication tools were conducted; 3D printers and a laser cutter. The observations from the first phase led to the interview of six craft practitioners to gain a broader meaning of the role digital technology plays in modern craft practices. After analysing the data gathered from the semi-structured interviews, a design task titled Tabeer was devised. Tabeer comprised of an Islamic Geometric Pattern that four participants were asked to interpret and rework using one form of digital technology. Following PBAR as a reflective practitioner, I engaged with Tabeer as a reflective practitioner (see Volume 2). The fieldwork phases are discussed in detail in the next sections.

4.2 Phase 1

Experiment with 3D printers

The overarching research question at the beginning was to investigate why and in what ways do craftspeople utilise digital technology in craft. As a reflective practitioner, I wanted to engage with a 3D printer as a basis to understand how it works. A needle on a 3D software was designed with the help of a technician at a maker space. A needle was chosen as variances could be easily spotted because of it's pointy shape.

Figure 29: Image of the needle in the 3D software (Author's own, 2022)

The digital file was sent to four 3D printers sitting next to each other loaded with PLA (polyactic acid) filament. The printing of the needle began simultaneously and took about 20 minutes.

The needles were compared with each other and the irregularities in their appearances were noted. The differences suggested that digital fabrication tools are dependent on the craftsperson that operates them and that mistakes occur in machines as well. This experiment revealed that digital fabrication tools are fallible like Pye's (1968) workmanship of risk.

4.3 Phase 1

Talaash: Experiment with laser cutter

Talaash, part of the iAtelier programme, aimed to encourage sharing of knowledge and to foster collaborations between participants with digital and creative skills. Talaash was carried out in partnership with jewellery artist Tusheeta David in May 2022. This experiment followed the methodology of Variable Project (Marcus, 2016) that deliberately introduced mistakes into machinery.
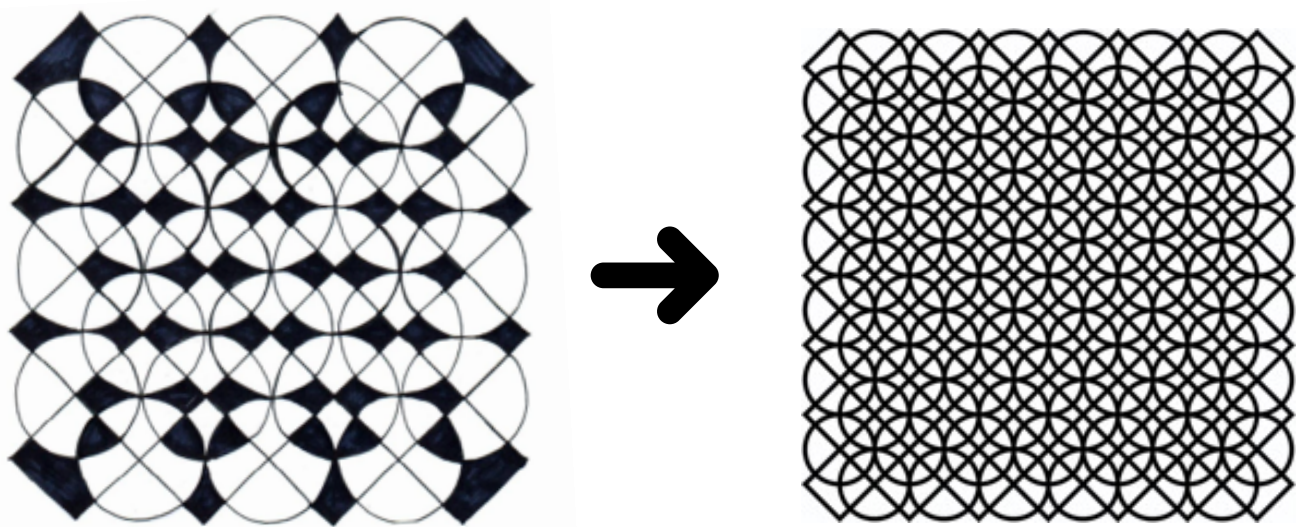

Figure 30: The hand drawing turned into a digital pattern (Author' own, 2022)

I hand drew an Islamic Geometric Pattern on paper and Tusheeta constructed it digitally on CorelDRAW, a digital software that uses vector graphics for designing. Islamic Geometric Patterns are perfectly symmetrical and any flaws that arose from the laser cutter would be easily identifiable on the fabric. Tusheeta made variations of the original pattern on the digital software to have a selection of patterns to work with.

The patterns were laser cut on a variety of fabrics of different weights, textures and weaves. Different settings were tried, and twenty-five samples and one final piece were produced but not one of the samples was cut perfectly and the emerging insights was that perhaps digitally operated machines are fallible and similar to craft in that respect. Again, this experiment revealed that digital technology is a tool that needs the craftsperson to engage with it and to learn it like any other tool. The next section details the second phase of the fieldwork.
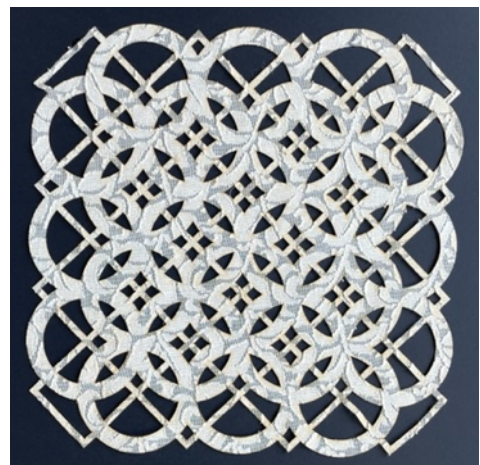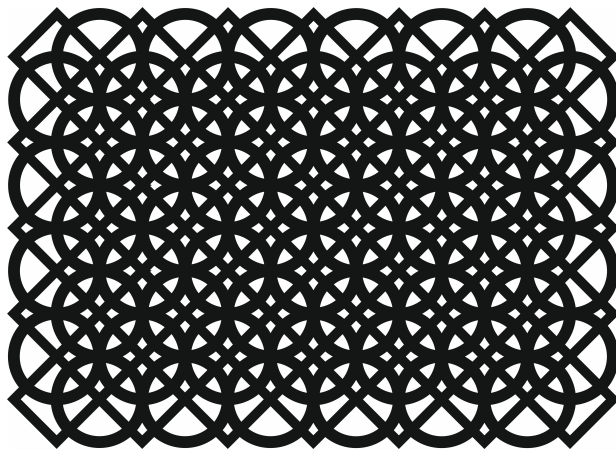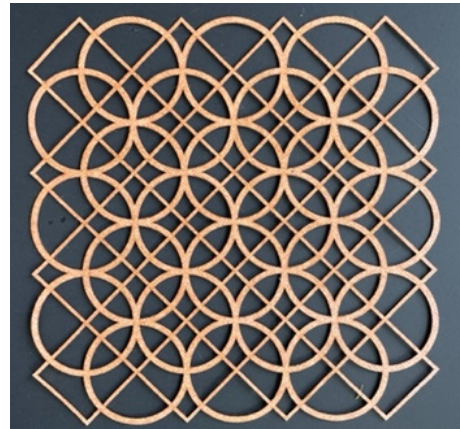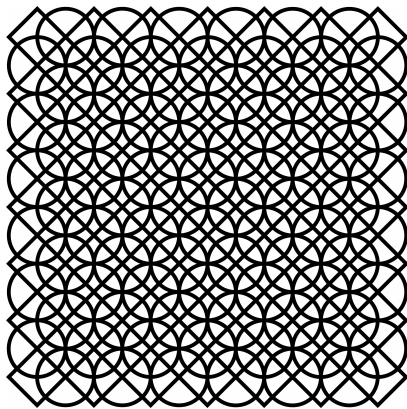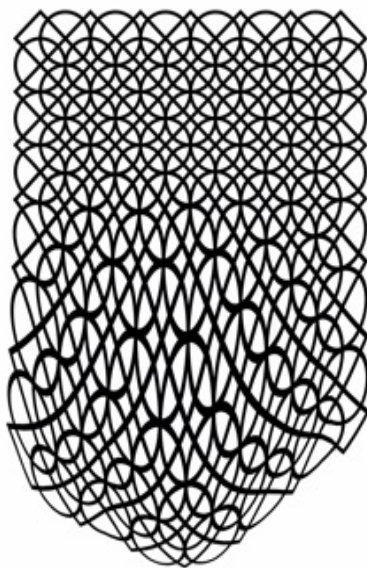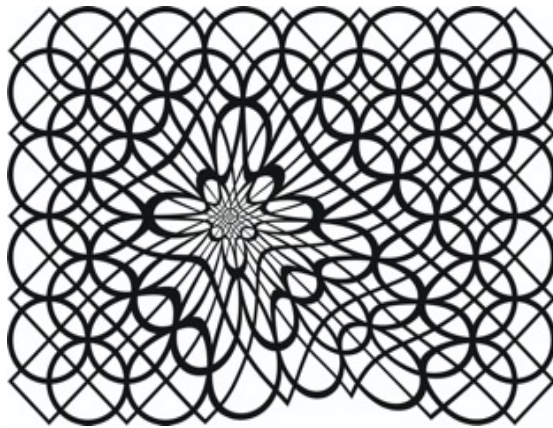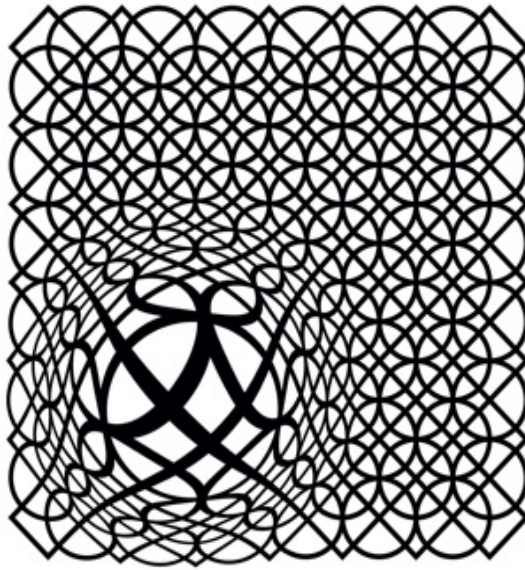
Figure 31: Variations of the pattern and their corresponding laser cut fabrics (Author's own,2022)

4.4 Phase 2

Semi-structured interviews

Six craft practitioners were interviewed in the second phase of the fieldwork. The following diagram lays out the descriptions of the participants (section 3.7).

Jewellery designer maker	Technician/Maker	Maverick maker
Process Junkie	Woven Textile Designer	Ceramicist
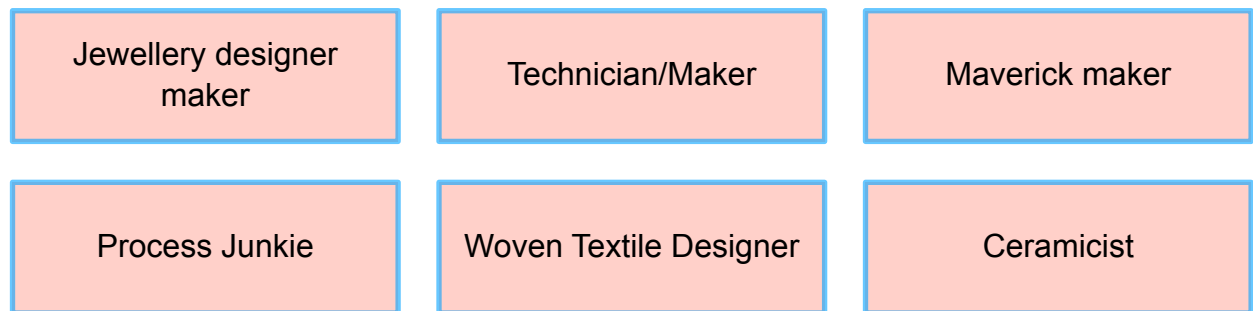
Figure 32: How the participants describe themselves (Author's own, 2022)

The researcher let the participants lead the conversation but had a topic guide (figure 33).

1. Tell me about your practice?
2. What motivates you to use digital technology in your craft?
3. How does the advancing digital technology affect hand skills?
4. How important is it for you to physically touch your materials in your design process?
5. How important is craft and tacit knowledge for the craft practitioner to take full advantage of digital technological making methods?
6. Can you give me one word for craft and one word for technology?

Figure 33: Topic guide for interviews (Author's own, 2022)

The participants were eager to share their experiences of working with digital technology in their making and were generous with their time and thoughts. The

participants spoke about the efficiency of digital technology and how it enables them to achieve designs that cannot be achieved by the human hand.

4.4.1 Analysis of semi-structured interviews

The six interviews were audio recorded, transcribed and read five times to familiarise with the data. Next the codes were organised with pen and highlighters on the hard copies of the interview transcripts (Maguire and Delahunt, 2017).
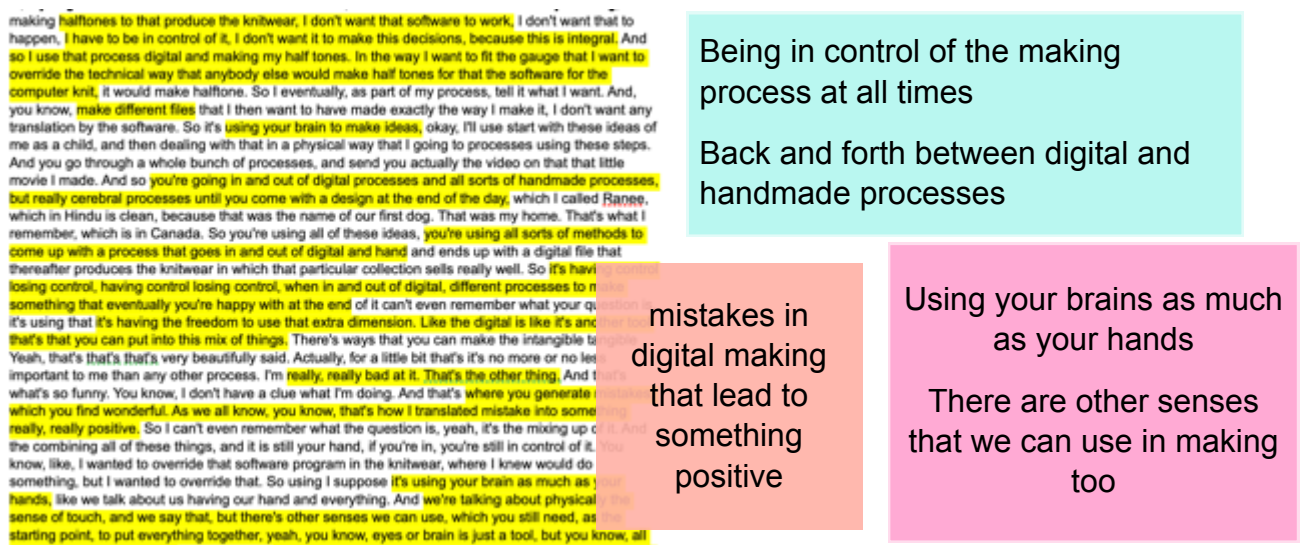
Figure 34: Initial annotation of interview transcripts (Author's own, 2022)

Capturing interesting and relevant insights in response to the research question from the interview data, the codes were not pre-determined and developed as the coding process progressed (Maguire and Delahunt, 2017). The codes were consolidated to generate common themes and key insights about the perception, motivation and experience of craftspeople working with digital technology. The themes were then organised into broader themes that suggested that tacit knowledge is important in realising the potential of digital technology in craft practices. The themes were reviewed and used in planning for the final phase of the fieldwork which is detailed in the next section.

Codes	Themes	Broader Themes
Crap in crap out	Importance of knowledge of skills, materials and processes	Tacit Knowledge
Extension of the hand	Enhancer	Quality of digital technology
Crapject	Making digitally without craft knowledge or experience leads to useless piece of objects	Tacit Knowledge
Hunger for making by hand or machine	Challenge	Curiosity
Sitting next to Nellie	Absorbing knowledge by observation	Tacit Knowledge
Learn a new language	Curiosity	Challenge
Lack of hand skills	Enabler	Quality of digital technology
To make objects that are not humanly possible	Precision and efficiency	Quality of digital technology
Tool	Tool	Tool
Making with the head rather than the hand	Craft knowledge and experience	Tacit Knowledge
Curiosity	Challenge	Innovation
People fear that using digital technology will not leave any fingerprints on their finished piece	hand-making vs digitally assisted products	Tacit Knowledge

Figure 35: Mapping codes and highlighting themes for analysis (Author's own, 2022)

4.5 Phase 3

Tabeer: Design Task
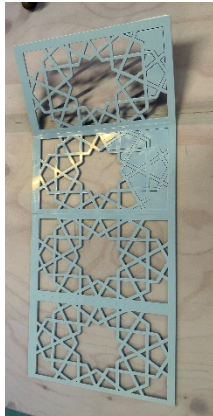
Building on from the insights from phase 2, a design task was devised to test the importance of tacit knowledge and to allow the participants to reflect on the role of digital technology in their craft. An Islamic geometric pattern was hand drawn and sent to four participants to interpret, rework and craft an artefact using digital technology in the process. An Islamic pattern (see volume 2 page 56) was used because it is complex and requires critical thinking and tacit knowledge to work into an artefact. The design task, Tabeer translates to interpretation in Urdu. The

68

participants were given three weeks to complete Tabeer. Nellie contracted Covid and could not finish the task. However, she agreed to reflect on the process by answering the questions. The topic guide (figure 36) was similar and repetitive to the questions asked in the interviews in order to see if the answers had changed or thinking evolved by taking part in the reflective design process.

1. What are your three favourite tools?

2. What does digital technology mean to you?

3. Do you feel that a background knowledge of craft, material and processes helps in taking advantage of digital making tools?

4. In what ways does digital technology support your making process?

Figure 36: Topic guide for dissemination of Tabeer (Author's own, 2022)

The emphasis of the design task was for the participants to reflect on the design process and not the artefact produced. The participants were conscious in their making and thus able to provide richer insights on their observations, process and experiences. Fleur and Nellie replied to the questions by email while Bob and Meera discussed their findings on Zoom. The data collected was thematically analysed by generating codes and collating them into themes which are discussed in the next chapter.

	Rumi	Meera	Fleur	Nellie
Tabeer				Couldn't complete task because of Covid
3 Favourite Tools	"I don't have favourite tools. I have a repertoire of equipment that I can use and utilise for all sorts of different things depending on what we are working on."	• Laser Cutter • Saucepan • Pendant Drill	• Potter's Knife • Hole Punch • Clay Gun	"I need to think exactly what part of making that I am referring to. I might answer differently for different things." • Computer • Pencil • Paper
Does a background Knowledge of craft, material and processes support making with Digital tools?	" Oh God Yeah Absolutely. … It makes life easier but you have got to be able to translate one thing into another."	"I would say it works the other way around. For me my understanding of digital technology helps me with my craft and how to use my tools."	"I find that the two sets of skills, hand making and digital, can be complementary but that it takes time to find how you can apply one to the other."	"I personally think that background knowledge is absolutely imperative to digital design."
Does Digital technology support your making process?	• Intricate sculptural parts that can be 3D printed • Multiples of the same thing • Speeds up making process	• CoralDraw and Photoshop are crucial for using the Laser cutter • Digital manipulation of patterns to create new patterns.	"However, the way I use them it doesn't yet directly relates to my hand making processes…..I am keen to observe how other makers are using the new technology to better understand how it might apply to my own practice."	"Digital technology is fairly key in all my making processes." " I manipulate imagery digitally. It helps as a design tool to keep things original - the play between digital and reality forms a path that is one's own so that interplay aids originality which is so important in design, for me at least. if I am generating imagery then i often use printmaking as a first process, and then digitally manipulate that imagery to get finally to something that i can use in knitwear or glass making which i also do."

Could you have carried out the Tabeer task without the support of digital technology?	Yes but it would have taken days.	"No, the design process involved using and exploring the pattern using digital software."	Yes, but would take longer and use more physical resources.	Not applicable as participant couldn't complete task.
Has this exercise helped you in your making?	–	Yes, it has given her new ideas to combine organic forms (that she normally works with) with the symmetrical Islamic Geometric Patterns.	This has been fun. Also gave me great ideas for new earring designs!	"I so enjoy this type of analysing. I think we really do need to understand what we do and why. This is good to make us think about these things. I miss that lack of study too often."

Figure 37: Initial analysis of the data gathered from dissemination of Tabeer (Author's own, 2022)

4.6 Initial Analysis of data generated

With a social constructivist approach, the motivations, perceptions and experiences of the participants engagement with digital tools (figure 38) revealed that the participants see digital technology primarily as an efficient tool that enhances their making process.

	Rumi	Meera	Tara	Skye	Nellie	Fleur
To make designs/objects that are beyond human capabilities	✔	✔		✔		
To make designs/objects that cannot be made due to physical disability	✔		✔		✔	
Out of Curiosity	✔	✔	✔			✔
To make designs/objects that cannot be made due to lack of hand skills				✔	✔	✔
To save time	✔	✔	✔	✔	✔	
To bring efficiency to the design process	✔	✔			✔	
As a Tool	✔	✔	✔	✔	✔	✔
As a challenge	✔		✔			
To explore design possibilities/ideas	✔	✔	✔			✔
To make something different		✔				✔
To keep up with the growing use of technology in work practice	✔					

	Rumi	Meera	Tara	Skye	Nellie	Fleur
To explore larger scale						✔
As a tool for collaboration						✔
To make multiple copies of an object	✔					
To save materials and resources in experimentation						✔
To present ideas for commissions and installations		✔				✔
For accuracy and precision	✔	✔				✔
As a means to make thoughts tangible	✔	✔	✔		✔	✔

Figure 38: Motivational factor of participant engagement with digital tools (Author's own, 2022)

The participants see potential and possibilities of design development beyond the capabilities of the human hand in digital tools. Meera stated that she could not have designed the artefact for Tabeer without digital tools. However, Nellie and Rumi disagree; they mention that it is possible, but it will take much more time and resources, establishing that digital tools save time. Fleur provides a different perspective as the ever advancing digital software and tools mean that she has to constantly update her knowledge and skill set making digital tools time consuming. Fleur's motivation for incorporating digital tools in her making aligns with Sennett's (2009) notion of experimenting with tools to realise their potential. Tools need to be held, used, utilised, manipulated and controlled (Nimkulrat, 2016) and the participants show how they select and adapt their digital tools. Fleur has honed her digital tool, the keynote software to use it for something other than it was intended for. She says:

Although this is a presentation tool, I have developed a way of manipulating images in a very simple way to quickly let me play with pattern, scale and colour. (Fleur)

The participants elaborate on their experience of working with digital tools and how they are in control at all times because digital tools form only a step of their making process and never the whole process (Volume 2, section 4.11) as Meera explains.

I definitely use it more as a tool and additional tool in my kit. Rather than something that takes over and has control I feel like I have control on what I am hoping to achieve from the machine. (Meera)

To understand the relationship between craft and digital technology, the participants were asked to provide one word each for craft and digital technology (figure 39).
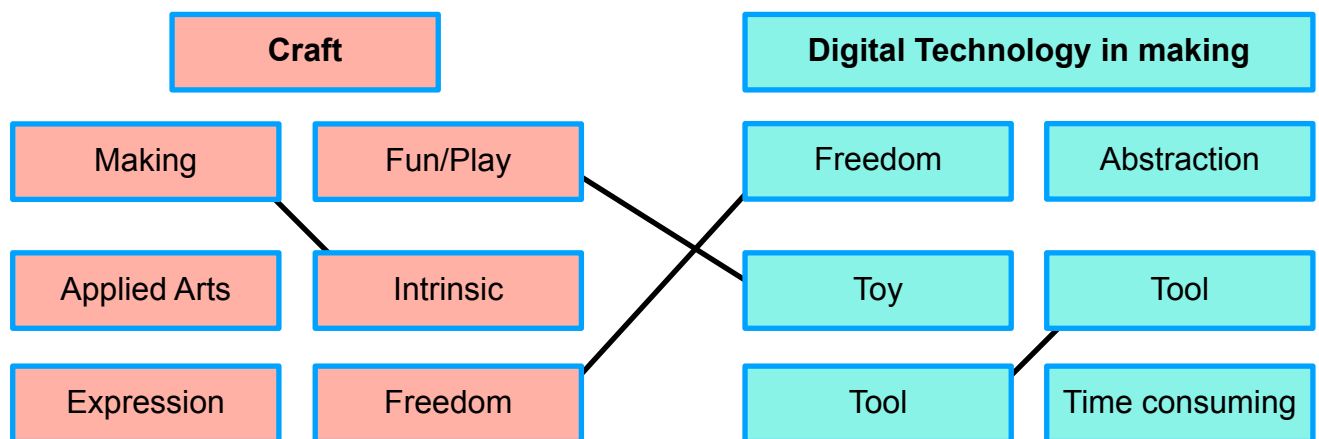

Figure 39: The words given to craft and digital technology by the participants. (Author's own, 2022)

The analysis revealed an interesting overlap of similarities suggesting that craft and digital technology are similar processes as the following quote by Rumi indicates:

[..] it is the same. They are one in the same. (Rumi)

Making with digital tools is the same cerebral process as making with the hands contends Nellie. An interesting word for digital technology was time-consuming as digital tools are associated with efficiency. Like Fleur, Rumi explains that learning digital softwares and operating digital tools requires time and dedication.

it is quicker to hand sculpt sometimes. (Rumi)

4.7 Summary

This Chapter laid out the three fieldwork phases in detail. The first phase comprised of two experiments; one with a 3D printer and one with a laser cutter. For the second phase semi-structured interviews of six craft practitioners with craft and technology hybrid practice were carried out to gain a better understanding of the motivation and experiences of craftspeople to incorporate digital technology in their making. The third phase included a design kit, Tabeer comprising of an Islamic Geometric Pattern that was sent to four participants to interpret and craft an object using one form of digital technology. A questionnaire was sent to two participants and discussion with the other two was held on Zoom to reflect on the participants' observations and experiences.

5

Discussion and Analysis

5.1 Introduction

This practice-based research has evolved in an iterative cyclic nature of observation, planning, action and reflection. The overarching research question was to investigate the role of digital technology in craft and Dormer's (1997) quote was regarded as a starting point of this research. The key finding of this research is that the intersection between craft and digital technology in craft practices is much wider that I had envisioned at the beginning of this research.
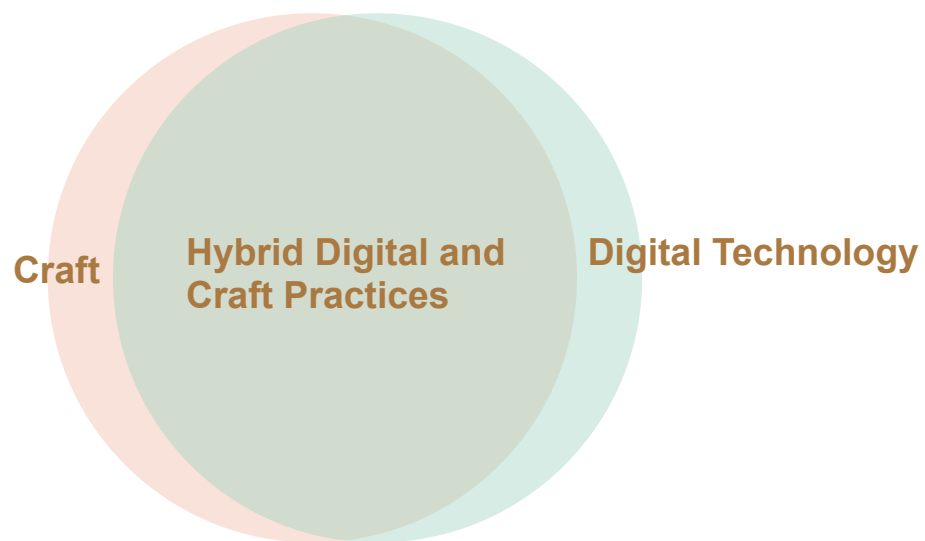

Figure 22: Overlapping hybrid digital and craft practices
(Author's own, 2022)

Thematic Analysis was instrumental in extracting the nuances in the gathered data from the interviews and after the dissemination of Tabeer to arrive at a better understanding of the findings. The emerging insights were collated into two main themes as follows:

1. Workmanship of risk

2. Significance of tacit knowledge

5.2 Workmanship of risk

Working with digital tools can sometimes lead to generating mistakes that can lead to dynamic discoveries (Sennett, 2009; Shillito 2013). The statement by Sennett was observed in my scoping experiments and was restated by Rumi as he carried out Tabeer. The laser cutter during Talaash, would leave some areas of the pattern engraved rather than cut through or it would burn the edges of the finer cloths. Not one fabric sample was cut as programmed (see appendix). While making the object for Tabeer, Rumi set to laser cut acrylic with the Tabeer pattern but it also did not cut through completely (figure 41).
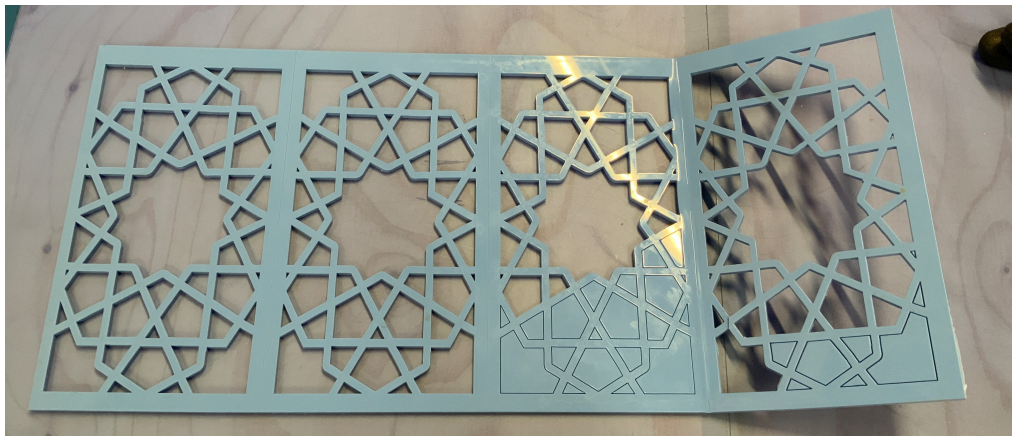

Figure 41: Rumi's laser cut acrylic sheet (Photo courtesy: Rumi, 2022)

Rumi's intention was to strip bend the laser cut sections into a cube, but the strip bender was damaged to the point of no repair. He had planned to insert 3D printed sheets of plastic (figure 42) into the cube and put a light source to project shadows outside. However, the object could not be completed due to the faulty machines. The limitation of this exercise could be that it is one instance and a meaning cannot be constructed from it. Rumi's Tabeer paired with my scoping experiments act as emerging insights that digital technology is fallible and unpredictable. This rejects the findings of Marcus (2016) who concluded that mistakes can only be deliberately programmed by the human hand. The variables found in the 3D printed needles and

the faulty laser cutter promote Pye's (1968) workmanship of risk (see 2.3) to the technological process indicating that it is possible to locate this workmanship in a digital fabrication tool.

5.3 Tacit Knowledge

Rumi's engineering background and knowledge of machinery came in handy when he started working in the creative arts with digital fabrication tools. Validating Rumi's experience, Tara strongly advocates students to learn drawing and making by hand before moving onto CAD softwares. She echoes Dormer's (1997) sentiments about learning the basics first and reasons that physical objects made with digital tools are meant for the physical world and need to be made by physical materials and processes so it's imperative to start from the physical hand before moving on to the digital realm. Meera agrees that by learning hand skills you can control the machine better, anticipate the results you hope to achieve and bring originality to your work. Tacit knowledge that Dormer (1997), McCullough (1998), Nimulrat (2016) and Shillito (2022) highlight as being crucial for the utilisation of digital technology in craft practices is now evidenced through participant thoughts and reflections.

Material knowledge is important in realising the potential of digital tools. Tara states that designers without the knowledge of the properties of materials and processes misuse digital tools. She gives the example of a novice designer who does not understand the potential or possibilities of digital fabrication tools and gets an object 3D printed without knowing that a laser cutter would have done the job better. Nellie adds that without craft knowledge the final product will never have the integrity it needs to be called a good design. The perceptions of quality, integrity and good design varies for each viewer. What constitutes a 'good design' is recognised as a topic for future research but cannot be achieved in the time frame of this research.

Skye agrees that jacquard woven fabrics can look 'flat' if you do not have the background weave knowledge of how the structures can be manipulated to produce an original piece of work. Fleur adds:

Figure 42: 3D printed plastic that Rumi intended to insert in the cube (Photo courtesy: Rumi, 2022)

Making skills in ceramics are based muscle memory and learned response to the touch and feel of material at key stages of its drying (Fleur)

Nellie challenges the necessity of 'touch' in the making process and provides a different and unique perspective. Nellie posits that's we possess four other senses apart from touch that we can use to inform our experiences. Digital tools may deny craftspeople the sense of 'touch' but it makes the other senses including the imagination work in innovative ways. For example, Nellie comments on how designing virtually for a project with a virtual reality headset 'blew away her mind' and expanded her creativity in unknown ways and the loss of touch was a small price to pay. Nellie has acquired tacit knowledge by working with a range of materials and processes for over a decade and applied her knowledge to 'making' virtually which resulted in a positive experience for her. Later on, in the interview, Nellie states that the reason she doesn't need to physically engage with her materials for instance

deciding on which yarn to spin with, is because she already possesses the tacit knowledge of yarns. Craft and material knowledge embed in the craftsperson as tacit knowledge after some time: it is the fundamental, baseline knowledge that craftspeople posses but cannot articulate in words to others. Tara gives an example of novice designers that lack craft and tacit knowledge; designers without physical tools or a work bench who use the services of companies offering to 3D print or laser cut objects from any image sent to them. These designers get their pieces of jewellery digitally made but are oblivious to how that piece of jewellery would sit on a person's neck.

5.4 Design of research process and methods

An iterative consciously reflective and reflexive attitude in par with practice-based-action-research (PBAR) was adopted for this study. PBAR as a methodology allowed me to capture insights in an iterative consciously reflective and reflexive process. As Candy (2020) and McNiff (2002) outline, a reflective practitioner within PBAR, generates meaning and a better understanding of the research by actively engaging with materials, tools, technologies and participants in a reflection-in-action approach (Schon, 1983). By working with the participants and assessing their responses, I was able to design and evaluate the research methods as the research unfolded. Tacit knowledge emerged within the reciprocal nature of the PBAR framework. Central to Polanyi's (1967) beliefs and validated by several scholars (Make,2007, Peterelli, 2017) knowledge resides in the craftsperson as tacit; it is embodied in the design process and the artefacts produced (Cross, 1982). The data generated and the woven fabrics (Volume 2) became tangible representations and visual documentations of the research findings. The PBAR model provided an apt framework to draw out and display tacit knowledge when working with digital tools. PBAR allowed me to imbue concepts of research into my practice to drive my

practice forward in a completely new and innovative way. It enabled me to draw narratives about tactility, tacit knowledge and the role of digital within craft. This framework can be applied to future research projects of a similar nature.

5.5 Answering the research question

Having discussed the themes emergent from the data collected, I will now return to the research question to evaluate how the themes led to a better understanding of the research context.

5.5.1 Research question: What is the role of digital technology in craft practices?

The data implies that digital technology plays the role of an essential tool in craft; an efficient tool that enables craftspeople to explore beyond their capabilities. It enhances and transforms intangible thoughts and ideas generated in the human brain into tangible objects. Digital tools are enablers and enhancers; you start with an idea and it shows you a whole set of possibilities that you hadn't thought of. Hand making and digital tools are complimentary; they require the same cerebral processes and tacit knowledge to flourish.

5.5.2 Sub question: What role does tacit knowledge play in taking advantage of digital technology in craft practices?

The findings from the research postulate the important role of tacit knowledge in realising the potential of digital technology in craft practices. Tacit knowledge is at the core of craft making; it is a platform on which good design is built as shown by the participants. Tacit knowledge is acquired over many years of physically engaging with materials and processes. Its importance in the designing, development and execution of a well-made object by digital and physical tools was cited by all participants.

5.6 Summary

Working with digital tools need not be a linear process; craft practitioners can go back and forth between the hand and digital to learn from both processes. But what enhances and elevates the experience of working with the ever-advancing digital tools is the craft experience and the tacit knowledge that craftspeople posses. It is crucial to build on craft knowledge and skills by engaging with materials and processes; to observe and learn the embodied tacit Knowledge that enables and equips craftspeople to take charge of digital technology.

6

Conclusion

6.1 Conclusion

This experimental research project investigated the role of digital technology in hybrid practices which combine traditional making techniques with digital tools. The research gained insights from the participant's reflections on their motivations to integrate their craft knowledge and skills with digital making tools. Embracing digital technologies in craft practices is the future of making but a craft minded approach to designing and making will be mutually beneficial for the advancement and innovation for both craft and digital technology. The scoping hands-on experiments were a practical representation of Pye's (1968) workmanship of risk theory and elaborated on the synthesis between the hand-crafted and digital technologies; by bringing hand skills and tacit knowledge to working with digital technologies. This method can carry forward as a methodology to be used in researching tacit knowledge in other areas as well. It is significant to note that digitised tools are fallible and unpredictable and like craft in that manner. Overall, through experiments and a reflective-practitioner approach, this research has aimed to uncover the role of digital technology in craft practices. The tacit knowledge and craft experience of a craftsperson affects their engagement with digital technological tools. The future will see a lot more of incorporation of digital technologies in craft practices. We must learn from our traditional technique of making, to inform our technological future.

6.2 Future research

Having established the importance of tacit knowledge in hybridised craft practices, a future research project can look into the following topics:

1. The invisible role of the technician when operating technology

2. How craft practitioners harness and evolve digital tools

3. The implication of digital technology on the innovation of craft

4. The comparison between experienced craftspeople and novice makers to identify how tacit knowledge affects making with digital tools

7

References

- Alfoldy, S. and Press, M. (2007) "Handmade Futures: The emerging role of craft knowledge in our digital culture," in *Neocraft modernity and the Crafts*. Halifax (Canada): Press of the Nova Scotia College of Art and Design, pp. 249–266.

- Andrews, T., 2012. What is social constructionism?. Grounded theory review, 11(1).

- Barrett, E. & Bolt, B. (2010) Practice as research : approaches to creative arts enquiry. London: I. B. Tauris.

- Braddock, S.E. (1994) "Respect for tradition, curiosity for technology," in S.E. Braddock and M. O'Mahony (eds) Textiles and new technology: 2010. London: Artemis, pp. 18–23

- Braddock, S.E. (1994) "Respect for tradition, curiosity for technology," in S.E. Braddock and M. O'Mahony (eds) *Textiles and new technology: 2010*. London: Artemis, pp. 18–23.

- Candy, L. and Edmonds, E.A. (2002) Explorations in art and Technology. New York: Springer.

- Candy, L. and Edmonds, E.A. (2002) *Explorations in art and Technology*. New York: Springer.

- Candy, L., 2006. Practice based research: A guide. CCS report, 1(2), pp.1-19.

- Clarke, V. and Braun, V. (2017). Thematic Analysis. The Journal of Positive Psychology, 12(3), pp.297–298. doi:10.1080/17439760.2016.1262613.

- Cross, N. (1982). Designerly ways of knowing. Design Studies, [online] 3(4), pp.221–227. doi:10.1016/0142-694x(82)90040-0.

- Crotty, M.J., 1998. The foundations of social research: Meaning and perspective in the research process. The foundations of social research, pp.1-256.

- Douglas, E.P., 2017, June. Beyond the interpretive: Finding meaning in qualitative data. In 2017 ASEE Annual Conference & Exposition.

- Edelkoort, L. and Fimmano, P. (2019) Talking Textiles Waxman Textile Prize - The Finalists #2015, Trend Tablet |. Available at: https://www.trendtablet.com/ 4155-talking-textiles (Accessed: December 3, 2022).

- Edelkoort, L. and Fimmano, P. (2019) Talking Textiles Waxman Textile Prize - The Finalists #2015, Trend Tablet |. Available at: https://www.trendtablet.com/ 4155-talking-textiles (Accessed: December 3, 2022).

- Finlay, L., 2008. Introducing phenomenological research.

- French, N. (1997) "CADCAM and the British ceramics tableware industry," in P. Dormer (ed.) The culture of craft. Manchester: Manchester University Press, pp. 158–167.

- French, N. (1997) "CADCAM and the British ceramics tableware industry," in P. Dormer (ed.) *The culture of craft*. Manchester: Manchester University Press, pp. 158–167.

- Hagan, S.M. and Stolterman, E. (2007). ARTIFACT: THE INTERACTION OF PRACTICE AND THEORY. Artifact, 1(3), pp.131–133. doi:10.1080/17493460701872032.

- Hall, C. and Earley, R., 2019. Divide, Switch, Blend. Exploring two hats for industry entrepreneurship and academic practice-based textile design research. The Design Journal, 22(sup1), pp.19-35.

- Intangible Cultural Heritage Committee inscribes the traditional weaving of Al Sadu onto the Representative List of Humanity (no date) Intangible Cultural Heritage Committee Inscribes the Traditional Weaving of Al Sadu onto the Representative List of Humanity | Silk Roads Programme. Available at: https://en.unesco.org/silkroad/content/intangible-cultural-heritage-committee-inscribes-traditional-weaving-al-sadu-representative (Accessed: December 3, 2022).

- Intangible Cultural Heritage Committee Inscribes the Traditional Weaving of Al Sadu onto the Representative List of Humanity | Silk Roads Programme. Available at: https://en.unesco.org/silkroad/content/intangible-cultural-heritage-committee-inscribes-traditional-weaving-al-sadu-representative (Accessed: December 3, 2022).

- International Journal of Dsign. (2008.). The Nature of Design Practice and Implications for Interaction Design Research. [online] Available at: http://www.ijdesign.org/index.php/IJDesign/article/view/240/148.

- Jönsson, L. (2007) "Rethinking dichotomies: Crafts and the digital," in Neocraft modernity and the Crafts. Halifax (Canada): Press of the Nova Scotia College of Art and Design, pp. 240–248.

- Kourteva, E. and Mc Meel, D. (2017) "Entropy: Unpacking the form through Post Digital making," The Design Journal, 20(sup1). Available at: https://doi.org/10.1080/14606925.2017.1352726.

- Kourteva, E. and Mc Meel, D. (2017) "Entropy: Unpacking the form through Post Digital making," The Design Journal, 20(sup1). Available at: https://doi.org/10.1080/14606925.2017.1352726.

- Loh, P., Burry, J. and Wagenfeld, M., 2016. Reconsidering Pye's theory of making through digital craft practice: A theoretical framework towards continuous designing. Craft Research, 7(2), pp.187-206.

- Maguire, M. and Delahunt, B. (2017). Doing a thematic analysis: A practical, step-by-step guide for learning and teaching scholars. All Ireland Journal of Higher Education, [online] 9(3). Available at: https://ojs.aishe.org/index.php/aishe-j/article/view/335.

- Mäkelä, M. (2007). Knowing Through Making: The Role of the Artefact in Practice-led Research. Knowledge, Technology & Policy, 20(3), pp.157–163. doi:10.1007/s12130-007-9028-2.

- MARCUS, A.(2016) "Signal/Noise: Code and Craftin Architectural Drawing" .In eds. Lamere, J, and Alonso, C. (20170 Projects Catalog of the 37th Annual conference of the Association for Computer Aided design in Architecture, MIT, Boston.

- Marcus, A., Gonçalves, F.L. and Jia, H. (2016) Variable projects, Variable Projects. Available at: https://www.variableprojects.com/#/signal-noise/ (Accessed: December 7, 2022)

- Marcus, A., Gonçalves, F.L. and Jia, H. (no date) Variable projects, Variable Projects. Available at: https://www.variableprojects.com/#/signal-noise/ (Accessed: December 7, 2022).

- McCullough, M., 2015. The hand, across twenty years of digital craft. On-line: http://www-personal. umich. edu/~ mmmc/PAPERS/HandInDigitalCraft. pdf.

- Mcewan, M. and Scott, J., 2019, September. Deciphering the Craft of the Laser Cutter. In Proceedings of the International Conference 2019 of the DRS Special Interest Group on Experiential Knowledge (EKSIG 2019) (pp. 27-40). Estonian Academy of Arts.

- McNiff, J., 1995. Action research for professional development (pp. 137-151). Bournemouth, UK: Hyde.

- Niedderer, K. and Roworth-Stokes, S., 2007, November. The role and use of creative practice in research and its contribution to knowledge. In IASDR International Conference (Vol. 795).

- Niedderer, K., 2009, October. Understanding methods: Mapping the flow of methods, knowledge and rigour in design research methodology. In third international conference of the International Association of Societies of Design Research (IASDR 2009), Seoul, Korea. Retrieved January (Vol. 15, p. 2011).

- Oakley, P., 2010. Does Contemporary Craft Carry a Social Deficit? An analysis through comparison with related creative practices. Making Futures, 1(1), pp.239-248.

- Petrelli, D., 2017. On Tacit Knowledge in Design Research. Retrieved May, 19, p.2015.

- Pöllänen, S. (2012) "The meaning of craft: Craft makers' descriptions of craft as an occupation," Scandinavian Journal of Occupational Therapy, 20(3), pp. 217–227. Available at: https://doi.org/10.3109/11038128.2012.725182

- Pöllänen, S. (2012) "The meaning of craft: Craft makers' descriptions of craft as an occupation," Scandinavian Journal of Occupational Therapy, 20(3), pp. 217–227. Available at: https://doi.org/10.3109/11038128.2012.725182.

- Press, M. (2007) "Handmade Futures: The emerging role of craft knowledge in our digital culture," in Neocraft modernity and the Crafts. Halifax (Canada): Press of the Nova Scotia College of Art and Design, pp. 249–266.

- Rust, C., 2004. Design enquiry: Tacit knowledge and invention in science. Design issues, 20(4), pp.76-85.

- Ryall, H. and Macbeth, P. (2016) "The Digital Print Room- A bespoke approach to print technology," in Crafting textiles in the Digital age. London: Bloomsbury Visual Arts, pp. 77–89.

- Townsend, K. (2016) "Closely held secrets: Embodied knowledge in digitally crafted textiles," in N. Nimkulrat, F. Kane, and K. Walton (eds) Crafting textiles in the Digital age. London: Bloomsbury Visual Arts, pp. 189–206.

- Townsend, K. (2016) "Closely held secrets: Embodied knowledge in digitally crafted textiles," in N. Nimkulrat, F. Kane, and K. Walton (eds) *Crafting textiles in the Digital age*. London: Bloomsbury Visual Arts, pp. 189–206.

- Treadaway, C., 2007. Digital crafting and crafting the digital. The Design Journal, 10(2), pp.35-48.

- Treadaway, C.P., 2009, October. Hand e-craft: an investigation into hand use in digital creative practice. In Proceedings of the seventh ACM conference on Creativity and cognition (pp. 185-194).

- Vermillion, Joshua, 2005. The Digital Craftsperson: an investigation into digital tools | processes | craft. 10.13140/RG.2.2.20653.84963.

- Woolley, M. and Huddleston, R. (2016) "Maintaining the human touch-exploring 'crafted control' within an advanced textile production interface," in Crafting textiles in the Digital age. London: Bloomsbury Visual Arts, pp. 91–102

- Woolley, M. and Huddleston, R. (2016) "Maintaining the human touch-exploring 'crafted control' within an advanced textile production interface," in *Crafting textiles in the Digital age*. London: Bloomsbury Visual Arts, pp. 91–102.

- Yee, J., 2010. Methodological innovation in practice-based design doctorates. Journal of Research Practice, 6(2), p.M15.

8

Appendix

8.1 Reflection 1

A weaver reflects

I often have to explain to people why I studied the same under graduate programme (Textile design) twice at the Glasgow School of Art. After the first time I graduated from GSA, I decided to stay at home for seven years to raise my young family. When my younger son started Primary School, I met up with my tutor to look at options to restart my career. She suggested that I do a couple of years of undergrad again.

Why you ask? It was because the looms were more mechanised and the advancing technology meant that I would most likely struggle in the textile industry without the knowledge of operating the newer more technological looms. This makes me realise how fast technology is changing the way we approach craft making. It makes me wonder if the efficiency of the machines will take over the hand craft. Is technology a threat to craft? From what I have seen and gathered in Pakistan and China, technology has drastically shortened the time and effort it takes to create craft. Technology has enhanced the making process but are hand skills at risk of going instinct? Surely not.

The MRes will answer these questions.

Figure 43: Pulling warp barns through the dents in the reed (Author's own, 2022)

8.2 Reflection 2

The tale of the Mighty Dragon

Look at all these machines! Does making with the help of these technologically powered digital machines identify as craft. I suppose that these machines ease the craft making process for the makers. So what is Craft anyway? Craft is skill gained through laborious and meticulous hard work. It requires the craftsperson to invest years of sweat, blood and hours to master skills. I am not sure of these digital machines qualify as craft.

I'll see how the project Talaash progresses and if my thoughts change. I am here to work with T to see if the laser cutter is as perfect as we think it is or if it indeed makes mistakes. Making mistakes is a human quality and I think that this machine will churn out perfect soul-less pieces. This project is an exploration and a scoping experiment of sorts for my MRes. Hopefully I'll find some clarity after engaging with the laser cutter myself.

It has been a week since I have been working with the laser cutter. First of all, it is not as daunting as I thought it was. It is just another tool! A very difficult tool. It is like a dragon with a stubborn mind of its own. It breathes fire when and where it wants, leaving some areas engraved rather than cut through. Sometimes if the dragon is angry, it fires the cloth so heavily that it burns the edges! T and I are still trying to work out how to tame this dragon. It reminds me of first learning to weave. It took time and effort to learn to control the loom. So is the laser cutter just another tool like my loom? I suppose so. It certainly isn't as perfect as I had perceived. Not even one sample has come out of that dragon's mouth perfect! So craftspeople who use this machine are not just clicking buttons on their laptop to create beautifully crafted objects. They are also putting in effort and hard work. I need to research the motivations of craftspeople who use digital technology in their craft practice.

Figure 44: Laser cutting fabric for Talaash (Author's own, 2022)

8.3 Reflection 3

The Lost Loom

Precisely sixteen years and two months ago, I walked into the weave department at the Glasgow School of Art as an international student with a direct entry into the third year of the undergraduate Textile program. Mesmerised, I gazed at all the looms; countermarch floor looms, Dobby looms, hand looms and in the corner right next to the technician's office sat the AVL Dobby loom, a computerised loom with twenty-four shafts. The Compu-Dobby AVL Loom, an American loom was more mechanised than any loom I had woven on and could weave designs that I hadn't imagined possible!

I learnt weaving from Altaf baba, a Sindhi rural weaver with knowledge of all the traditional weave structures and who wove at the speed of lightning on a pit loom in my university in Karachi, Pakistan. Altaf baba taught us the basics of weaving on a frame loom first and then we progressed onto the countermarch looms that had a maximum number of six shafts tied to treadles. Alongside Altaf baba, our weave technician taught us to work out weave structures on squared paper. We always started with a straight or pointed draft and wove different variations of a plain, satin or twill weave. Twill weave is one of the strongest weave structures, the other two being plain weave and satin weave. Twill looks like diagonal lines and is most widely used in tweeds and denims.

Figure 45: Glasgow School of Art Weave Department (Author's own, 2022)

A weaving pattern consists of warp yarns that are the vertical lines and weft yarns that horizontally intersect the warp yarns to create a woven fabric or design. The design is the interlacement of warp yarns and weft yarns. One repeat of warp yarns is called the draft and one repeat of the weft yarns in the pattern is called the peg plan. The longest peg plan that I had worked with in Pakistan was 12 picks long which means that my repeat was made of 12 sequences of lifting the shafts. Imagine my delight when I learnt that I could weave a peg plan up to 300 picks long and spread on twenty-four shafts on the AVL loom! But the AVL loom was the weave department's pride and joy and was assigned to students strictly to be used in school hours under strict observation.

I learnt the weave software, Weavemaker and prepared my files to go onto the AVL. I wove tens of samples on the AVL as I could change the peg plan with just one click. Weavemaker itself was a software that amazed me. I could see a 3D rendition of the final cloth just by plotting in the draft and peg plan. Weavemaker allowed me to alter the peg plan and see if the design world work aesthetically. It saved time and gave birth to new ideas.

Forward seven years and I was back in the weave department at GSA. This time, the AVL had lost most of its glory and the new light was shining on the flashy Swiss Arm looms, computerised, quieter and more efficient looms. The AVL was clunky and the students dreaded having to weave on it. The Swiss Arm Looms on the other hand were more advanced and enabled the weavers to weave complex designs with much ease.
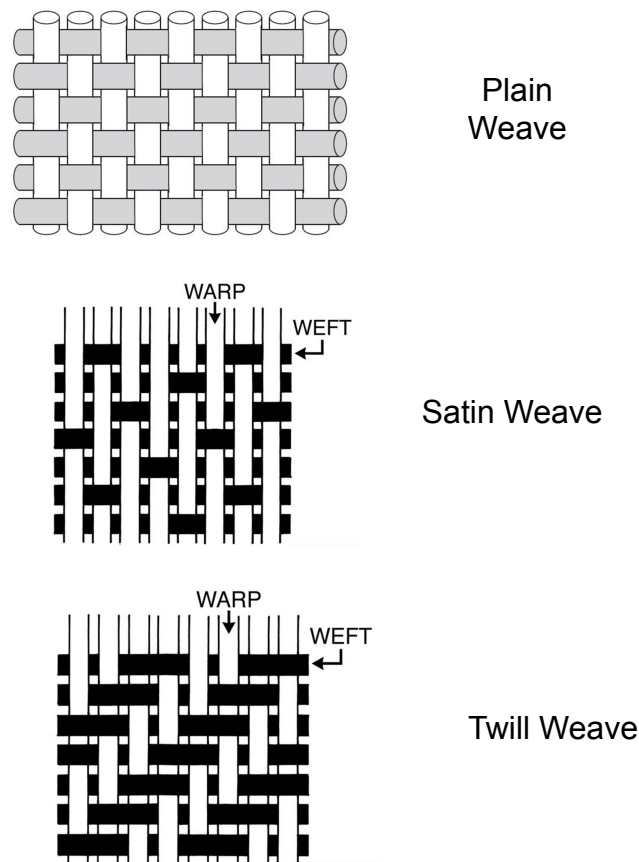
Figure 46: Basic Weaves (Author's own, 2022)

As part of my practice based research, I entered the weave department at GSA again to weave samples for my research project only to find the AVL gone and replaced by another Swiss Arm Loom. Upon asking the weave technician I was surprised to learn that she didn't even remember when the AVL had been taken away or where to. All she knew was that the AVL has stopped functioning reliably. The AVL loom hadn't just retired, it was declared dead and forgotten!

It is 2022 now and I am told by the weave technician that the model of the AVL looms are obsolete. They require the old version of laptops to work which are unfortunately impossible to find and maintain in a busy art school. Although the advancement of technology has given weavers better efficient looms, the AVL is lost forever!

THREADING DRAFT OF WARP ENDS

PEG PLAN
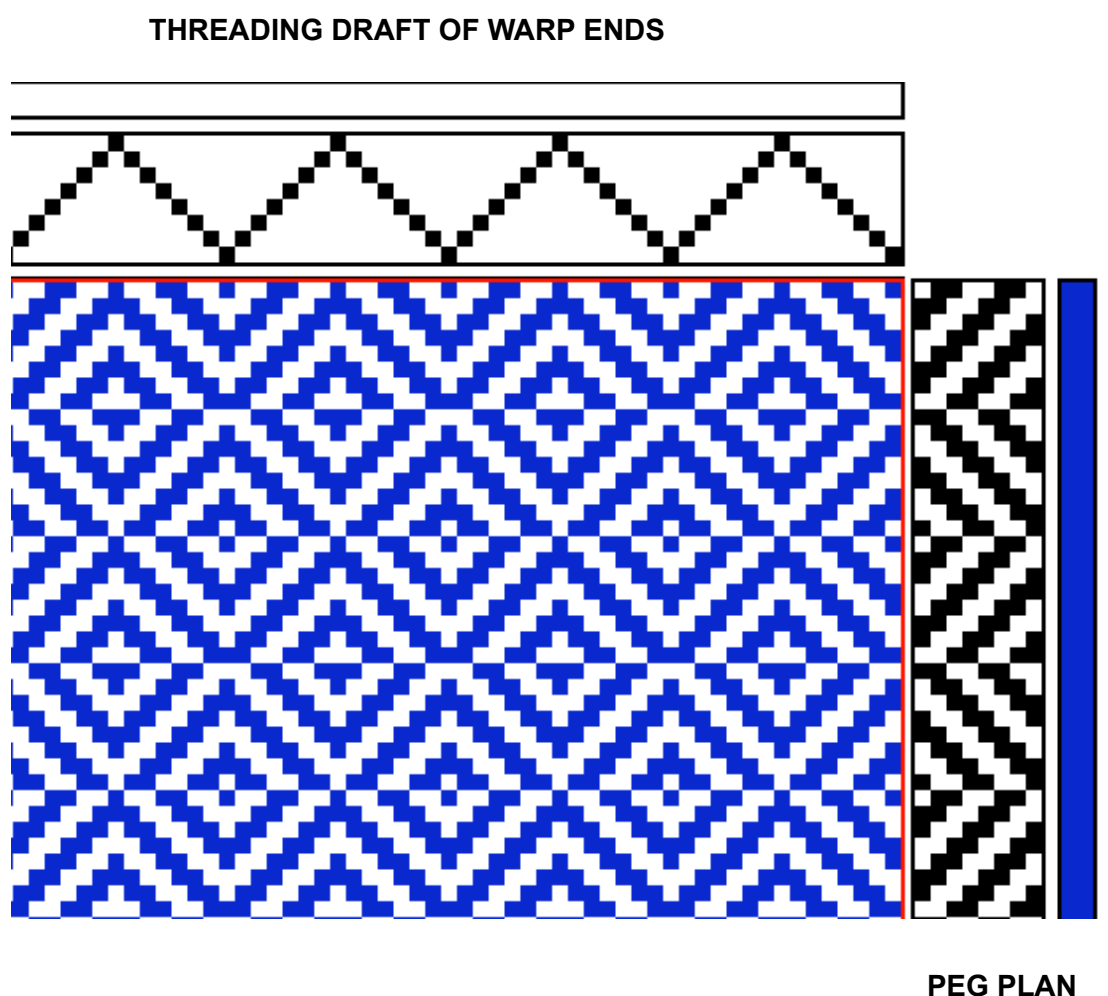
Figure 47: Weave draft (Author's own, 2022)

8.4 Reflection 4

Finding the right tension

How do you explain tension to a non-weaver or an amateur weaver? I have been trying to teach him how to weave but sometimes he pulls the weft too hard or sometimes he lets it go all loose which has made the selvedges look wonky.

I have demonstrated it far too many times but he doesn't understand. I have instructed not to pull the weft too hard as it draws the selvedges in. But he fails to keep the right tension. Am I not articulating it well enough for him to grasp the technique? How and when did I learn it? I am sure Altaf baba never taught me about maintaining the right tension. He just let us all weave and learn like learning to ride a bicycle.

This perhaps is my tacit knowledge; knowledge that is embedded in my very being from years of weaving, handling materials, drawing drafts and experimenting with weave techniques. We don't fully understand the importance of tacit knowledge until we have to explain someone to carry out a task that is second nature to us. I realise that it is tacit knowledge that has empowered me to take charge of new technologies in craft. I use the word empower because it makes me stronger and more confident to control my design process with all kinds of tools be it digital or analog. I am grateful to Altaf baba for teaching me the basics of weaving; beginning the design process by plotting on a graph paper and then moving onto the loom to experiment with different weights, colours, fibres and textures of yarns.

Figure 48: Weaving on a Dobby loom (Author's own, 2022)

## 8.5 Reflection 5

Islamic Geometric Patterns

On a trip to Hala, Pakistan, my interest in Islamic art was rekindled at the Shrine of the renowned Sufi Saint and Poet Shah Abdul Latin Bhitai. I was mesmerised with the ethereal beauty of Islamic Art. The more I looked at the geometric patterns, the more I was drawn towards them. What I find most intriguing about Islamic geometric patterns is the element of complexity and repetition: the eye travels around the pattern, never stopping on any one area which confirms the perfect harmony of the composition. Yet the Islamic artists make a minor flaw in the complex geometric patterns to signify that only Allah is perfect and humans are prone to making mistakes. I found this concept fascinating as it resonates with David Pye's theory of 'workmanship or risk' and 'workmanship of certainty'. The distinction that divides the handmade from the digitally created.

Funded by the Queen Elizabeth Scholarship Trust, I attended an eight day course at the Alqueria de Rosales in Spain in July 2022 learning to draw the fundamentals of Islamic Geometric Patterns. These patterns became the starting point of Talaash and Tabeer as I wanted to test Pye's workmanship of risk and workmanship of certainty theory against the pattern symmetry.
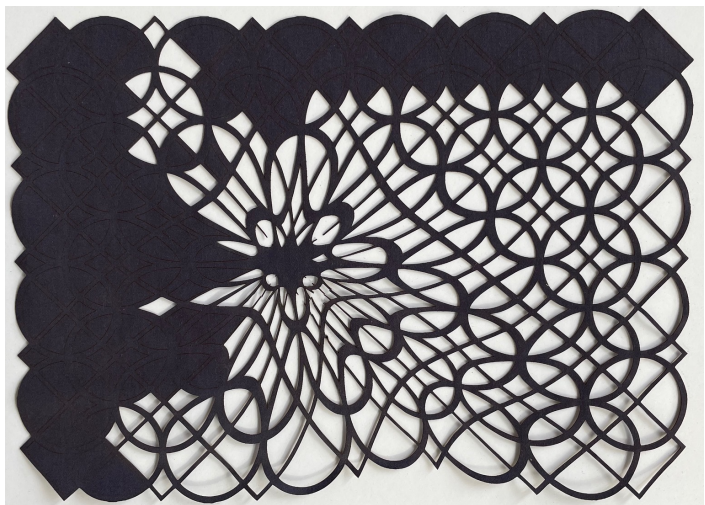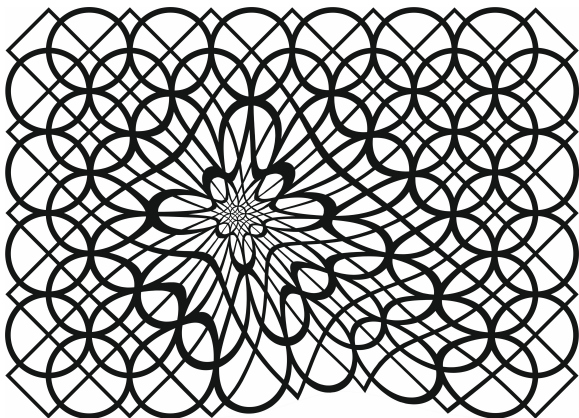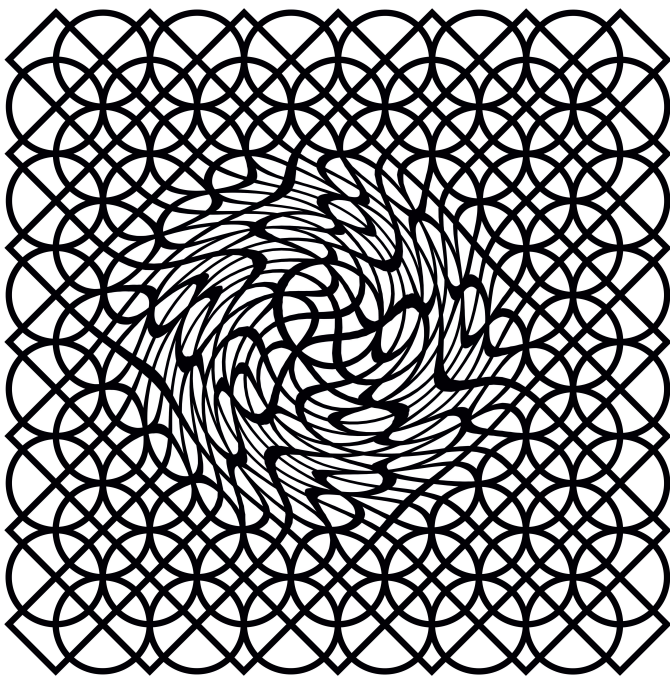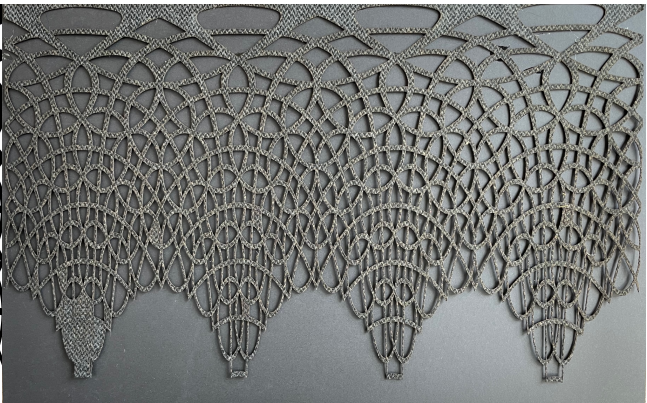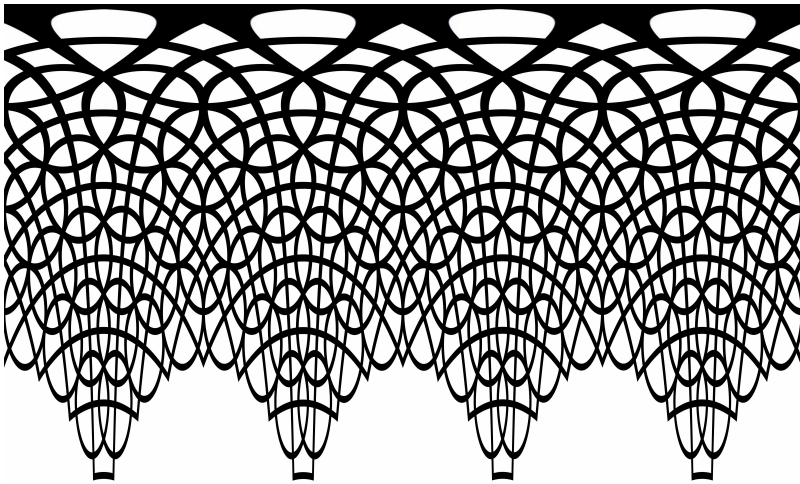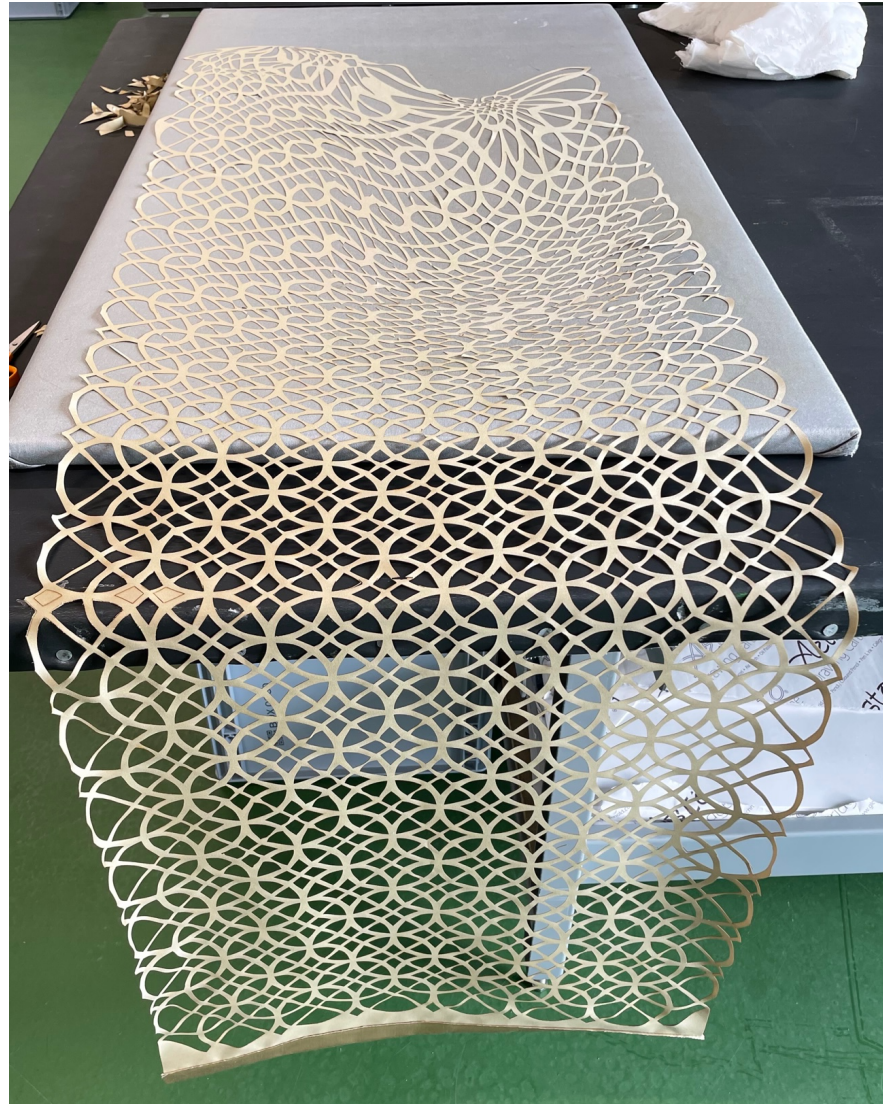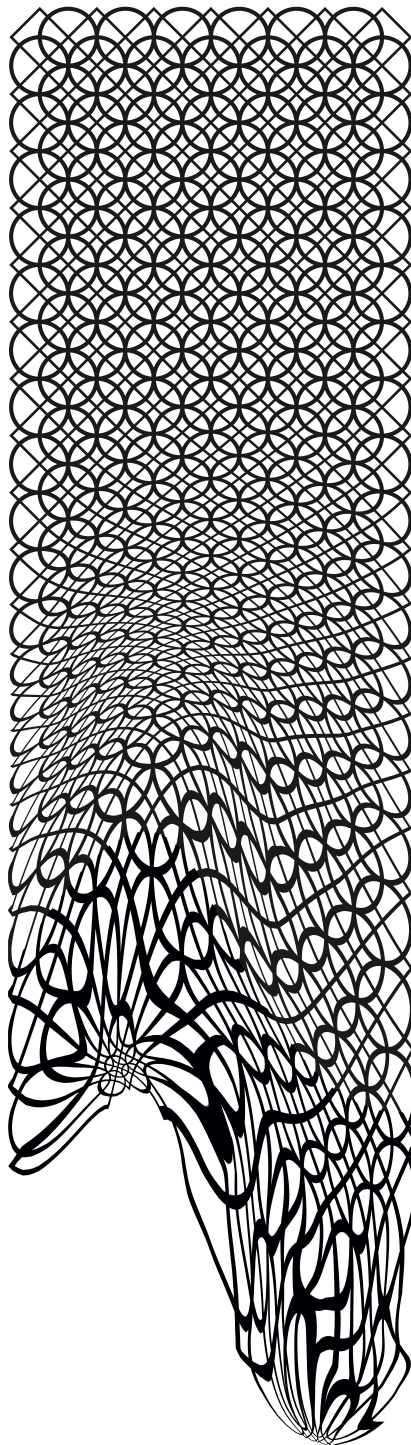

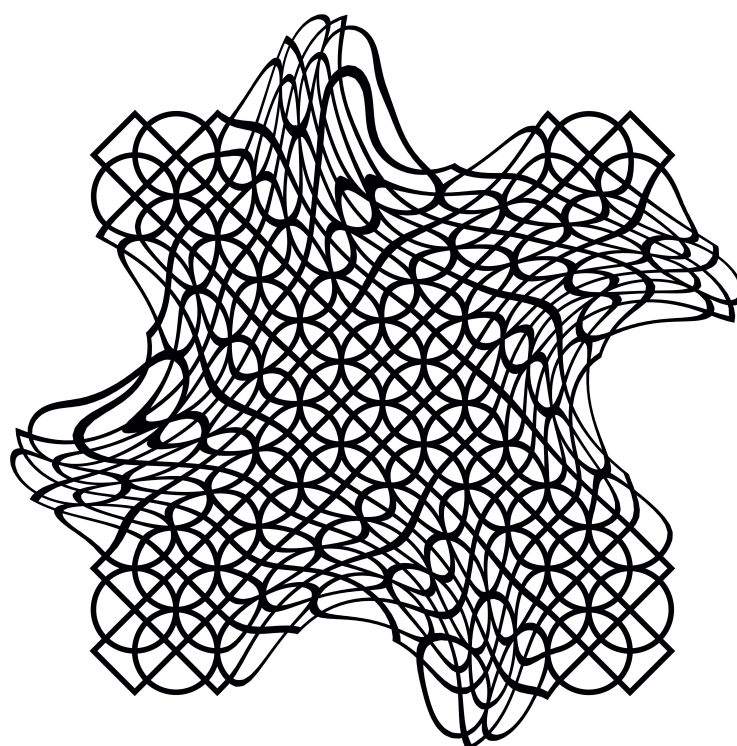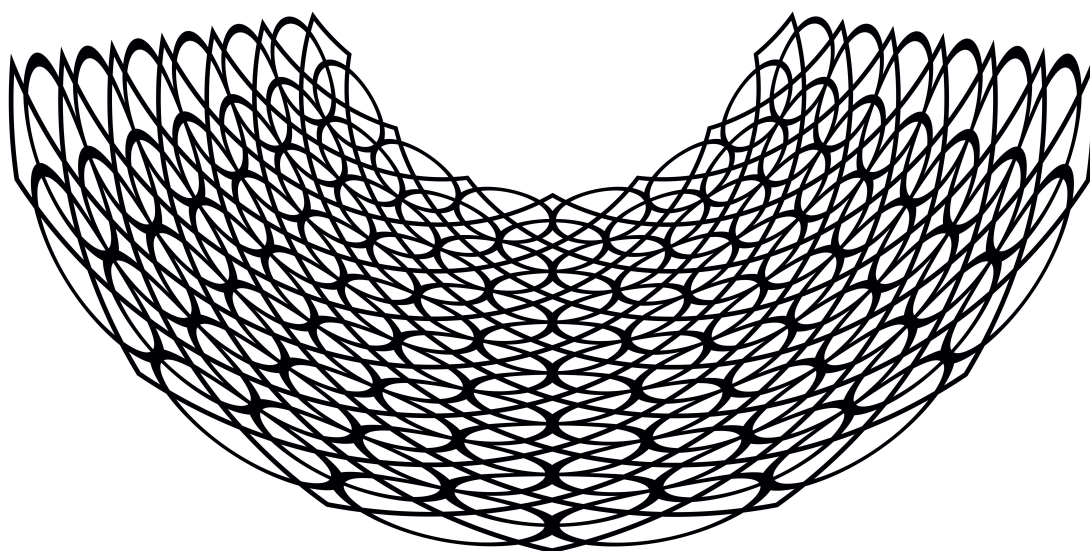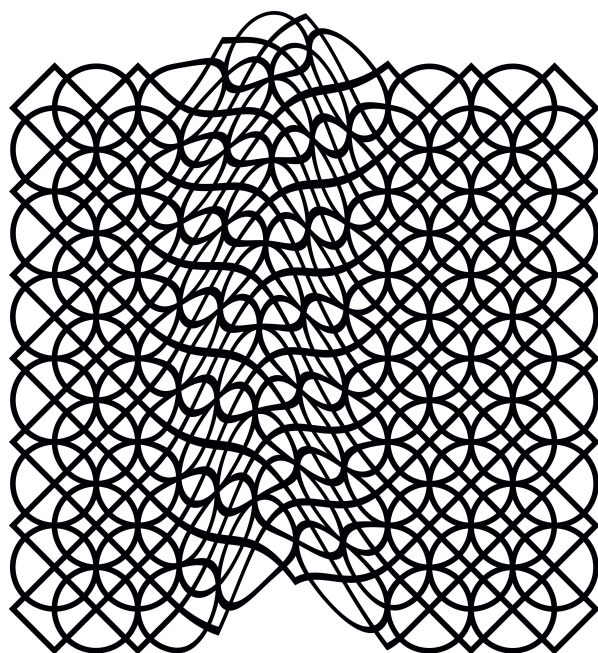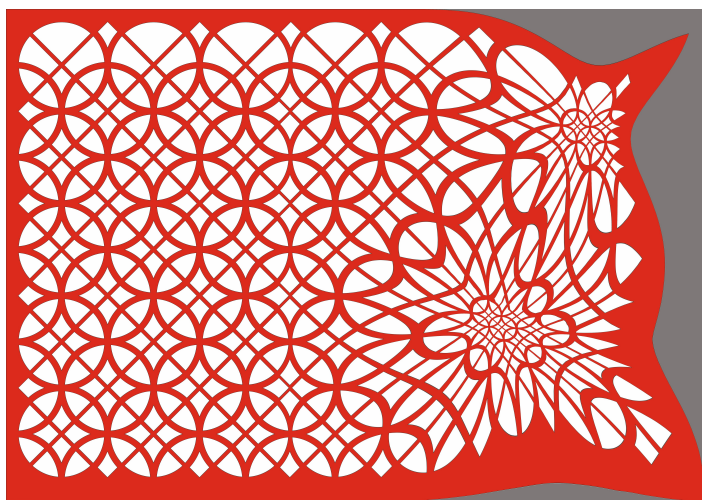*Figure 49: Drawing Islamic Patterns (Author's own, 2022)*

8.6 Talaash examples
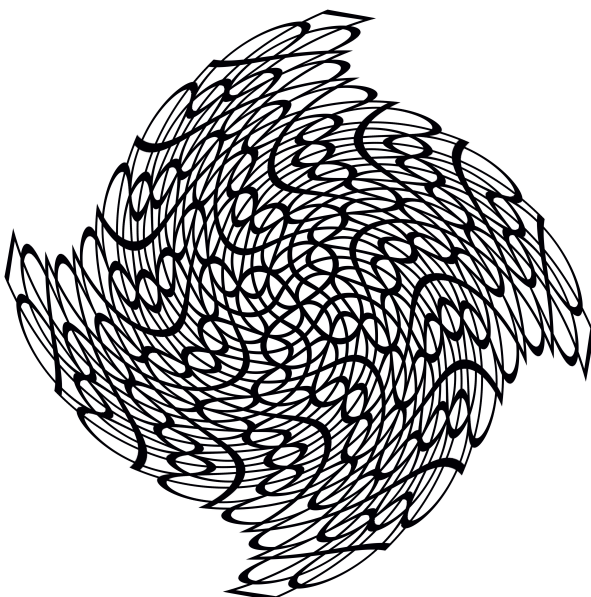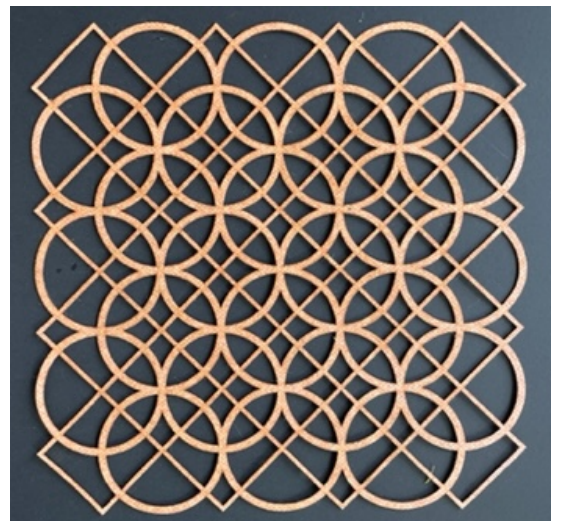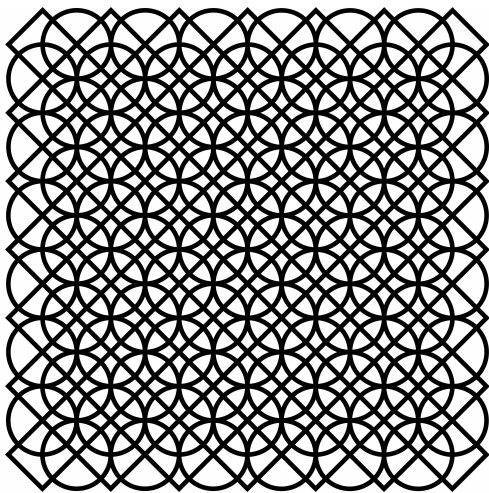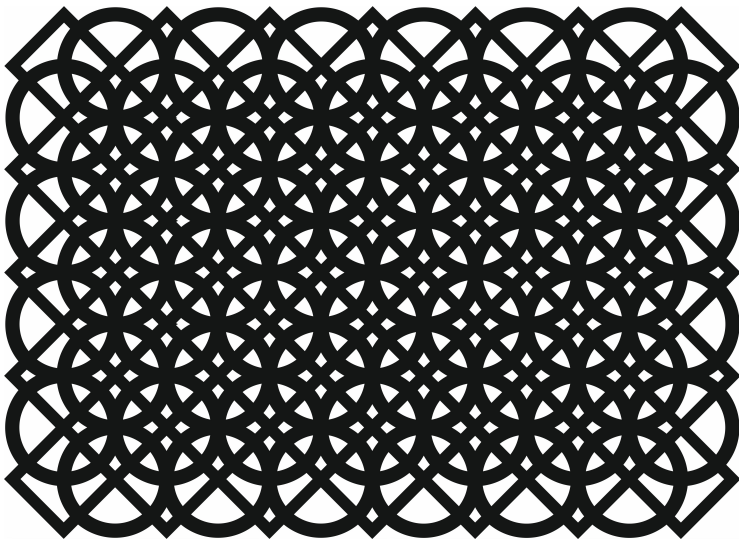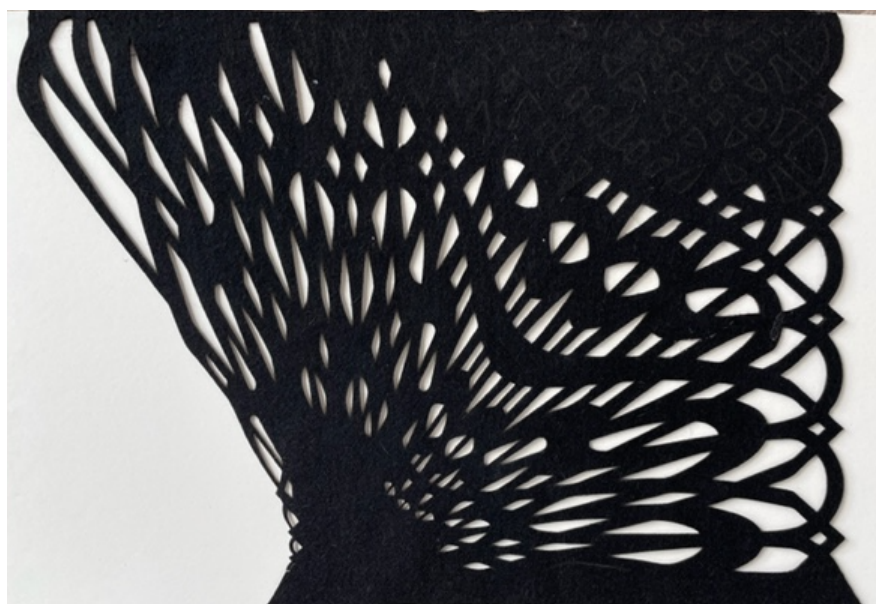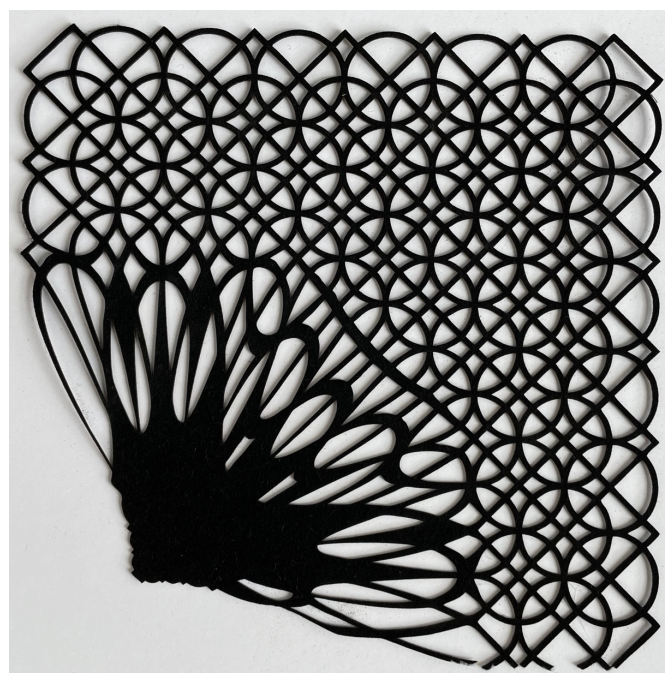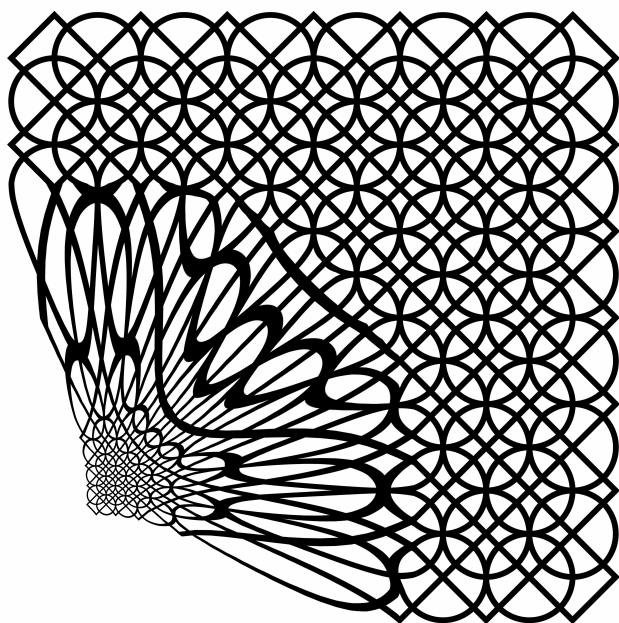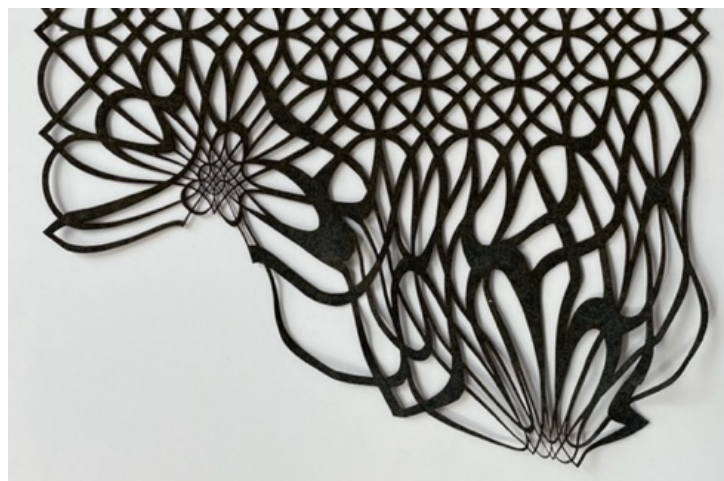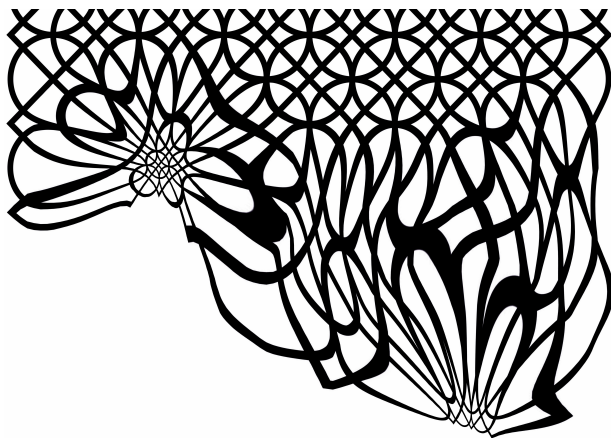
8.7 Information Sheet and Consent Form

GS°FA

PARTICIPANT INFORMATION SHEET

Hello, my name is Mariam Syed and I am student of the Master of Research programme at the Glasgow School of Art. My research project is titled ' Handwork Hand-work'. I would like to invite you for a research activity for my research.

About this Research Project:

Hand-work Hard-work: Craft as knowledge and Digital Craft

This research explores the relationship between a craftsperson and its digital tools in order to locate and understand the importance of tacit knowledge and craft experience in a craft-technology hybrid making practice.

Adding on to the rigid dichotomy between tradition and innovation of craft, this research project will identify and expand on the ways that digital fabrication tools can support and facilitate the innovation of traditional craft practices. The result of this research will aim to inform the reader of the hard-work that goes into producing an object using digital technology making methods.

Why have I been invited to take part?

You have been invited to participate in this research because your work is a successful example of the integration of digital technology with craft processes. I value your opinion and believe that your knowledge and expertise could make a significant contribution to this research project.

Do I have to take part?

Your participation in this research is completely voluntary and your consent to participate can be withdrawn at any time you are no longer comfortable with continuing.

If you decide to withdraw from the research, you will be asked for your consent to use what you have contributed up to the point of withdrawal.

Details of Participation

Participating in this research involves a research activity that will take approximately 8 hours of your time. Upon agreeing to participate, you will be sent an Islamic geometric Pattern digitally. You will be given 3 weeks to interpret, rework and craft an object with your choice of materials and processes using the pattern as a theme/source. You will be required to use at least one form of digital technology (either in designing or making of the object). You will be asked to take 3 photographs of your design process.

At the end of the 3 weeks, you will be invited to a short 30 minute discussion with the other participants to share about your experience of the design process. The discussion will be conducted and recorded on Zoom using my GSA licensed Zoom account. You can stop at any point and you do not have to answer any questions you do not want to.

With your consent, the discussion will be recorded and used by me as reference for the purpose of this research only. You will have the option to keep your camera off if you prefer to be audio-recorded only. Recordings will not be seen or shared publicly.

What will happen to the data from the discussion?

The data from the discussion will be transcribed and the quotes may be attributed to you. However, if you wish to be anonymised you will be given an option in the consent form and care will be taken to ensure that your identity is not revealed from any information in the interview.

1

PARTICIPANT INFORMATION SHEET

After transcribing, the recording of the discussion will be destroyed. Transcripts will be stored on a password protected file, accessible to me and my supervisors. They will be stored for up to ten years and then deleted.

With your permission, I would like to use the photographs of the design process to compliment the data gathered. I confirm that I have no claim on your work and all Intellectual Property of the work resides with the artist.

What will happen to the consent forms?

Consent forms will be deleted after they have been printed onto paper and these hard copies will be stored in a locked cabinet in the Haldane building on the GSA campus. They will be destroyed after ten years.

What are the possible benefits and risks of taking part?

The benefits of participating in this research are as follows:

1. Your contribution can make a significant difference in understanding the role of digital technology in modern making. Your invaluable knowledge and expertise will help other craft practitioners to better understand how tacit knowledge empowers the maker to take charge of digital technology techniques.

2. The input you provide will be indispensable for guiding designer makers at the helm of discovering how digital technology can foster innovation in traditional craft practices.

3. Taking part in this research will also promote your work to a wider audience.

There are no foreseeable risks or discomfort for you in taking part in this research project activity. You have the option to remain silent at any question that you do not wish to answer.

What will happen to the results of the research?

The results of this study will be part of a written thesis and may also be used in other written papers to further knowledge in this area. You will be updated on the progress of the research project and will be offered to view the summary of the findings. An online link of the final research will be shared with you on its completion.

If you have any questions or require more information about this study, please contact me using the following contact details:

Mariam Syed

Email: m.syed1@student.gsa.ac.uk

If you have any concerns about this project or if you wish to make a complaint about the conduct of the study, please contact the programme Leader

Professor Lynn-Sayers McHattie

Design Director - Postgraduate Research, Glasgow School of Art
Email: l.mchattie@gsa.ac.uk

Thank you for reading this information sheet and for considering to take part in this research activity. I am excited about your possibility of your participation and look forward to hearing from you.

Please keep this sheet for future reference.

Interview Consent For

GS₀FA

Research Project Title : *Between Tradition and Innovation: An investigation of the role of the designer at the intersection of craft and digital technology tools*

Lead Researcher: Mariam Syed
Contact Details: m.syed1@student.gsa.ac.uk
Phone: 07853008985

Please tick boxes

I confirm that I have read and understand the participant information sheet for the above study;

☐

I have had an opportunity to consider the information, ask questions and have had these answered satisfactorily;

☐

I agree to taking part in the study;

☐

I agree to being interviewed and audio/video recorded, and for these recordings to be transcribed as part of the research;

☐

I want to be anonymised for this interview and do not want any quotes attributed to me;

☐

I agree to being quoted and having my quotes attributed to me within publications, presentations, reports or examinable format (dissertation or thesis) for the purposes of research and teaching;

☐

I agree to images of my work being featured and attributed to me in publications, presentations, reports or examinable format (dissertation or thesis) for the purposes of research and teaching;

☐

I wish to receive a copy of the manual transcription of the interview;

☐

I am happy to be contacted about any future studies and agree that my personal contact details can be retained in accordance with the Data Protection Act 2018.

☐

_____	_____	_____
Name of participant	Date	Signature
_____	_____	_____
Researcher	Date	Signature

Complaints about the conduct of this research should be raised with Professor Lynn-Sayers McHattie at l.mchattie@gsa.ac.uk