Sneh Hazra
4 year professional Diploma in crafts design

Crafting and Science

Dissertação para obtenção do Grau de Mestre em
Arte e Ciência do Vidro e Cerâmica

Orientador: Professor Doctor Marcia Vilarigues
Assistant Professor
Head of the Department of Conservation and Restoration, FCT-NOVA
Director of the Research Unit VICARTE - Vidro e Cerâmica para as Artes

Co-orientador: Doctor Richard Craig Meitner,
Visiting artist, Faculdade de Ciências e Tecnologia,
Universidade Nova de Lisboa

Júri:

Presidente: Doutora Catarina Paula Oliveira de Matos Madureira Villamariz, Professora Auxiliar
Faculdade de Ciências e Tecnologia da Universidade NOVA de Lisboa

Arguente: Doutora Helena Catarina Silva Lebre Elias, Professora auxiliar
Faculdade de Belas Artes da Universidade de Lisboa

Arguente: Doutora Susana Coentro, investigadora
Faculdade de Ciências e Tecnologia da Universidade NOVA de Lisboa

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CRAFTING AND SCIENCE

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Abstract

Crafting and studying traditional craft practices interest me. From my experience of observing crafts in India, it seemed to me that crafting and the scientific method shared commonalities. The crafting process is systematic, there is an intricate play of thought and action, it is based on knowledge and experience and is an iterative process. This made me curious to know which similarities exist between crafting and science. And Vicarte was the ideal place to investigate my curiosity as I see Vicarte as confluence of science, arts and crafts in glass and ceramics.

My investigation includes an interesting experiment involving the borosilicate scientific equipment making process through which I attempt to find the similarities and differences between crafting and scientific method. For me this project was a vehicle to discover some essential aspects of crafting and to understand skill, tacit knowledge and how crafts, as opposed to popular belief, involve thinking.

I have come to realize that understanding crafts and the commonalities between crafting and the scientific method of investigation, is a study for a lifetime and there is a great deal to discover before I can begin to understand the nature of crafting this document is a compilation of my learnings until now of essential aspects and the vocabulary used in crafting.

Key words: Crafting, scientific method, skill, tacit knowledge

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Introduction

" A science is a systematized body of knowledge usually comprising of both facts and principles. It is derived from a sophisticated coordination of thought and action—thought in the form of hypothesis and inference, action in the form of experiment and observation. Thought, though starting with prior knowledge, is modified on the basis of experience, and is used as a guide to action, which in turn leads to new experience, which is used to generate new thoughts and so on. When coupled with publication and peer review of results, this iterative process is called the scientific method. It has been extraordinarily successful. It is as applicable to conservation and conservation research as to other practical applied endeavors"
Pg18,Chapter 2: The scientific method and conservation research, Principles of experimental design for art conservation research; Terry J Reedy & Chandra J Reedy; GCI scientific report program 1992

I see parallels between the description of the scientific method to what I had observed in Mr *Tincer's* workshop on this street called *'Thathero ka raasta'*(meaning the street of metal beaters) in the old parts of Jaipur, a city in the state of *Rajasthan*, India. As Mr *Tincer's* sat on the floor crafting 7 feet tall temple '*shikharas*' (tops or pinnacles of temple buildings, a common feature of traditional Indian architecture), every stroke of hammer on the brass metal sheets draped over wooden moulds was calculated. Strong enough to mould, soft enough to not puncture through the metal. The continuous clang of the hammer beating against the metal, dropping and soaring, based on how much Mr *Tincer's* wanted the metal to expand and from where in the shape. To me this felt like a sophisticated coordination of thought and action- Thought in the form of where and with what intensity the next hammer hit should be, and the action of delivering the hit precisely where needed , improvising the next hit based on previous ones. Crafting the '*shikharas'* involved a hypothesis - a careful assumption of a possible solution. That is the process involved in predetermining the different parts to of the whole form, the quantity of metal sheets and their thicknesses, the size of the moulds, and if whether they should be in wood, aluminum or a found object, the size of the pieces to cut so that they expand to the correct size after beating them thin into the forms ,and delegating parts of the process to members of his team based on their work experience and skill. The work plan was based on the knowledge and experience of having crafted innumerable *shikharas*, pots, pans and the likes, throughout the one hundred years that this family has been involved in this traditional craft, yet this prior knowledge was modified with newer experiences brought in with time. Crafting the '*shikharas*' was an iterative process as sometimes at the final step of making, Mr Tincer would go back to the first step, hammering carefully on the nearly finished piece with the big wooden mallet to fix that one bulge that had escaped his notice.

However, in the process of hammering the sheet into the mould, which as I mentioned above, felt to me, a sophisticated form of thought and action; Mr Tincer seemed to be doing it subconsciously and concurrently with shouting instructions to an apprentice, ordering another cup of *masala chai*(spiced tea) and admonishing his son to study better. It was as though he wasn't thinking of the whole hammering process at all. Those disturbances didn't interfere with the results or the finish of the object. The careful process of hammering continued, unassociated with- and undisturbed by the 'chaos'. That was more than careful, focused thinking. That process seemed as much in the body as in the mind. I found a word for it later, 'embodied knowledge'.

These various thoughts made me curious whether crafting bears similarities to scientific method.

Vicarte was the ideal place to investigate my curiosity. I see Vicarte as a confluence of science, arts and crafts in glass and ceramics. At Vicarte one can see, in varying degrees, what merging science, technology, arts and crafts can generate.

Essential terms

The first step in my investigation was to understand certain terms, concepts, and their meanings. They are:

What are crafts ?

The UNESCO convention(1996), concerning the protection of the world cultural and natural heritage, at the 20th session of the world heritage committee came up with a glossary of terms to define certain fundamental terms relating to crafts and culture. It states, "Products that are produced by artisans either completely by hand or with the help of hand tools or even mechanical means as long as the direct manual contribution of the artisan remains the most substantial component of the finished product. The special nature of the artisanal products derives from their distinctive features, which can be utilitarian, aesthetic, artistic, creative, culturally attached, decorative, functional, traditional, religiously symbolic and significant."[1]

By the UNESCO definition the list of objects and practices that can be identified as a craft are limited to material objects only. The definition holds manual labor essential to the process of crafting but ignores the knowledge involved.

I associate the word crafts with the skillful and thoughtful manipulation of materials. These materials could be, but are not necessarily tactile. These tactile materials can be traditional ones like wood, metal, clay, or contemporary ones like synthetic resins, PET and Bio plastics. But crafting can also involve intangible materials like words for a writer and notes for a musician.

Crafts may be intertwined with heritage and culture. Lino Tagliapietra, master glassblower, Murano, Italy, and Seattle describes crafts as follows, "It's impossible to define craft in a sentence or two. Sometimes in the US, people view craft as a laborers job, but in reality, craft is much more than that. In Europe, craft is an important and honored part of culture that is learned and dates back thousands of years. In Italian, the word for craftsman is '*artigiano*', which means creating art with culture in mind." [2]. Crafts could be made with contemporary materials as in weaving with ocean plastics, perhaps using a combination of digital and hand weaving, or designing software or coding[3]

Likewise crafts could be strictly utilitarian, or be symbolic representation to express beliefs and identities of the user and maker alike.

The term crafts in the 21st century is very inclusive and continues to include even more. I second the opinion of Joyce Lovelace a writer for American Craft's magazine, "in the past decade alone, with the rise of a new generation, we've seen the field(crafts) expand to include D.I.Y , Craftivism, and maker culture.

I very closely identify also with Glen Adamson's explanation of crafts. He states, "When many people hear the word "craft", they think of humble, decorative things: pots, baskets, or macramé plant hangers. But if we consider "craft" in its active form, treating it as a verb rather than a noun, we immediately realize it is, much broader than that. People "craft" things as diverse as theatrical set designs, couture gowns, sky scrapers and automobiles."

What is a scientific method ?

Science and scientific method is about systematic approach to study i.e systematic observation, logic and reasoning, qualifying and quantifying data, control of environment and variables in order to study results. Specificity is a feature of scientific processes.

Empirical evidence is of great importance in scientific method. 'A central theme of science and scientific method is that all evidence must be empirical or at least empirically based, that is, it should depend on evidence and results that can be observed by our senses.'[3]

The research cycle in the scientific method of investigation starts with a question, a curiosity or observation. We then generate a hypothesis based on our curiosity. A scientific hypothesis is a tentative answer to a question—sort of an explanation on trial. This hypothesis is then tested for its validity through carefully designed experimentation. Results from the experiments are then analyzed, and based on this analysis, the hypothesis is either validated or refuted. Informed by the knowledge generated, further hypotheses are generated for research.

Why crafts and science ?

I sensed some similarities between what has been described as a scientific method and craft practices that I had closely observed in India. The craft processes are systematic, is an intricate play of thought and action , but there is something more than just knowing and doing. This made me curious to know which similarities exist between crafts and science. Another reason to compare craftsmanship and scientific endeavors, is that comparing allows for better comprehension, helping to discover important details, and in expressing abstract ideas. The comparative study of crafting and the scientific methods of investigation, helped me to discover more about crafting.

The following are some research projects that have- or are studying 'making'. They were a huge inspiration and helped me through my investigation.

The Minding making project, Harvard University

The Minding Making project at the Harvard University emphasizes how making and thinking are inseparable. It aims to collapse the hierarchical separation between "minding" and "making" that has emerged through centuries of prioritizing head over hand in modern culture. 'Minding' means conceptual and abstract thoughts, knowledge that is conveyed verbally or mathematically. 'Making' means handwork, manual work, artisanal crafts, work done in factories and workshops. They are challenging the standard assumption that these two spheres are separate and are placed in linear hierarchy. [3]. The project aims to spark conversations about 'makerly intelligence' that are shared across artistic, artisanal, scientific and industrial boundaries. For example, in one of the workshops, involved exploring different maneuvers across various spheres, the project traveled from a saw mill to a high-tech neurobiology laboratory. "Though working across widely different scales and materials, the brain scientist and the saw mill operator shared an underlying language of cutting, and spoke of similar concerns in their distinct but comparable processes."[3]

The project aims to foster empathy across ethnic, cultural and socio-economic divides, and to re-frame the way we understand the relationship between conceptual and material knowledge. Reading about the project helped reaffirm my faith that I might find some interesting similarities between two spheres i.e the scientific method and crafting in my project. It also helped me understand how objects themselves can be rich sources of knowledge and the ways in which knowledge is embedded in making.

ARTETECHNE- technique in the Arts, Utrecht University

This project involves interdisciplinary research. That is, along with using conventional tools of research in technical art history and humanities it involves hands-on recreating of recipes from craft manuals and historical recipe books to discover information that the making process holds.

For example one of the projects called " Back to Burgundian Black" was an interdisciplinary project involving expertise of museum curators, academic researchers, organic dye specialists, and a contemporary artist, recreating the splendour of historical black dye technologies, specifically the Burgundian era black .The process involved a careful research into what pre modern workshops might have looked and felt like. Also it attempted to decipher the material culture and technical secrets of pigment and dye-makers. In addition, the results helped to study the ways one might improve on the perception of black shades in museums.

The resources I was able to consult from this project helped me understand the amount of information 'making processes' can hold, and how that information can 'be read'..

Video documentation by Paul Craddock, cultural historian and professional film maker

I was additionally inspired by the video articles by Paul Craddock..These video articles are about research topics that are tricky to put into words like bodily experiences and sensing. Paul Cradock prefers the medium of filming to study and research subjects such as the effect of environment on learning , embodied knowledge, and the influence of materials and sensory experiences on the development of embodied knowledge. Projects such as the video article titled Exploring the Entanglement of Sites, Tools, and Bodily Possibilities in an Academic Gathering and fabric bodies were very inspiring for my own project.[5]

Citation

[1] "Traditional Craftsmanship." UNESCO, ich.unesco.org/en/ traditional-craftsmanship-00057.

[2] Lovelace, Joyce. "Craft: Seriously, What Does the Word Mean?" American Craft Council, American Craft Magazine , 2018

[3] "The Scientific Method and Conservation Research." Principles of Experimental Design for Art Conservation Research GCI Scientific Program Report, by Terry J. Reedy and Chandra L. Reedy, Getty Conservation Inst., 1992, pp. 11–21.

[4]Minding Making. Harvard University, Retrieved October 18, 2020, from https://marlon-kuzmick-jpbk.squarespace.com/

[5] Craddock, P., & Harris, A. (2020). Workshopping: Exploring the Entanglement of Sites, Tools, and Bodily Possibilities in an Academic Gathering. Journal of Embodied Research, 3(1), 2 (16:17). DOI: http://doi.org/10.16995/jer.30

Experimental design

The plan

My attempt through this experiment was to identify, if any, the similarities between crafting and the scientific method. From my little time spent at Vicarte understanding glass technology and doing science experiments, I understand that empirical evidence is a fundamental feature in a scientific method. Empirical evidence allows for the verification and reproducibility of scientific discoveries and eventual progress of science. Hence, the plan to investigate my questions was to create a record(a visual / written) of a crafting process. If the results(or objects) can be repeated with similar accuracy by referring to that record, then hand making follows a scientific method. If by referring to my records results cannot be repeated with similar accuracy , then the hand making method may have the role of skill and embodied knowledge.

For this experiment I chose borosilicate equipment making processes. The practice of borosilicate equipment making generates a scientific end product, yet the process involves hand crafting which made this interesting process to study

The objects

The study was conducted using three objects . Two of the objects were scientific instruments ,and one was a non scientific object . The scientific instruments were a test tube and a simplified combination reaction receiver tube. The non scientific instrument was a set of two interlocking squares made in borosilicate solid rods. The participants were given three attempts to make the objects. Each attempt, irrespective of its completeness was preserved.

Object 1

The first object, a scientific equipment, was a test tube. The making of this object required a few basic steps of heating, joining and blowing.

As stated, three attempts were given to each participant to craft the object , The first two attempts allowed the use of measuring tools the third attempt did not allow for their use, in order to study if one builds on the ability to judge /sense measurement.

Object 2

Object 2 is a scientific lab instrument called a conversion receiver and reaction tube.The standard height of the instrument is about 120mm and includes a mould formed mouth that is available prefabricated and heat-fused in the end. A simplified version of this lab instrument, without the tapered ends, was chosen as model for this study . The choice to reduce the complexity of the form was in order to simplify the process of making consistent with the goals of this study.

As it was with object 1, three attempts were given to the participants to craft object 2. However the third attempt was performed on the day after the first two attempts. This was in order to see if a time gap allows for better results that may result from making associations and analogies.

Object 3

The interlocking squares is one of the basic exercises for beginners in flame working. It requires simple maneuvers :of bending ,cutting and joining. As with the other objects, three attempts were given to craft object 3, all on the same day. Through this object I wanted to observe the process employed to craft the object as close to the drawing as possible.

The record

I wanted to generate a record, similar to a scientific record of experiments, to document the process of making of the three above mentioned objects. I chose to film the making process with a subjective view.[8] I believe a film record will be comparatively unbiased as opposed to a written document. Text documents of the making process (especially in this case, where most participants in this experiment, including myself, were non-native speakers of English) may be influenced by the writer's capabilities with words and the participant's capabilities of understanding. Also text documents may carry the view and perspective of the writer. A video will help to bring to light the subject's point of view in the making process. Also it may cover any shortcomings of writing in a scientific experiment report which might affect the reproducibility of the object.

In the final films, that were used as a reference to show the process to the participants, I have only illustrated the successful process of making. I have left out the mistakes and not so successful attempts at crafting the objects. Following are the links to the film records used for the experiment:

Film link for object 1: https://drive.google.com/file/d/1ySGqrRbTX9en652AkXObCdolmRWVGoF1/view?usp=sharing

Film link for object 2: https://drive.google.com/file/d/14_faHBJTmvbGJPa0UlZrD8xtWk_F6azY/view?usp=sharing

Film link for object 3: https://drive.google.com/file/d/1nbHbauxqoqV-QmeuGC4hxzOsN0agAdX_/view?usp=sharin

The Participants

The experiment involved two participant categories: very skilled and beginners. The categorization is broadly based on the number of years of experience. The very skilled category is based on 10 or more years of experience. This categorization is based on the ten thousand hour rule, Which is three to four hours of practice everyday for 10 years [Pg 172, Sennet,2008]. Information published in 'The cognitive neuroscience of creativity' paper by Arne Dietrich, states the 10-year rule of deep immersion precedes creative master level work. And a beginner is defined by someone who has experience ranging from a few days to less than 5 years.

I had three volunteers for the experiment, due to time and social distancing restraints posed by the current circumstances. Participant A was highly skilled, Participant B was a beginner but with vast experience and expertise in other fields of making and crafting and Participant C, a beginner with skills in visualizing forms in space, an architect by profession. The participants are as follows:

Senhor Zé Luis

Senhor Zé Luis has over 33 years of experience in the borosilicate equipment making process. He trained as a glass technician in borosilicate equipment-making at he university of Aveiro, Portugal. His experience revolves around making and repair of scientific equipment in glass. He is one of the rare persons able to work with pure silica glasses which require considerable skill to work with.

Participant A

Skill: Very skilled

Description: Participant A is a glass artist with more that 25 years of expertise in his field.

Flame working experience: +10 years of hands on flame working and close to 20 years of observing this technique.

Other experiences: Participant A has experience and skill in a multitude of contemporary and traditional glass making

processes, and possesses a huge knowledge base for making in a vast array of materials and techniques. His skills and experience include wood working, metal casting, furnace glass blowing, teaching, designing. To help illustrate the variety and depth of skill and material knowledge, Participant A can assemble machinery and blow traditional, intricate tazzas with equal élan .

Participant B

Skill: Beginner

Flame working experience: 1-2 years of hands on experience of flame working in glass, close to 10 years of observing this technique.

Other experience :Glass blowing, glass casting and kilnworking, stained glass, mould making, plaster, ceramic,

Description: Participant B is a glass artist with 10 years of expertise in the field, and additionally, a background in mathematics, arts and crafts technique in glass ,and teaching

From observation at a personal level, Participant B is a magician in casting with glass. Precision is second nature in her works and processes.

Participant C

Skill: Beginner , 1 week workshop in flameworking at Vicarte, with less than 1 year of observing this technique

Flame working experience : A few days

Other experiences: Architect, Urbanist and Interior designer

Description: Participant C is an architect, urbanist and interior designer by profession and has an experience of 30 years in her field .She also designs furniture as a professional.

From observation at a personal level participant C has an incredible sense of measurement and can accurately guess measurements without the use of measuring instruments

Observations

The following are some key observations from the experiment:

- For all objects, every participant applied their own method of crafting.
- Improvisations were observed while crafting - One improvises based on one's skill, experience and familiarity with the tools and environment.
- The crafting process used by the participants was influenced by their previous experiences of glass blowing , artistic flame working and influenced by the tools that they use in their practice.
- With successive attempts, the results improved. The third attempt was better than the first in most cases.
- Crafting scientific as well as the non-scientific objects consists of many steps. To get the object right, it was important to perform each of those steps well. Each step would influence the quality of the final object.
- Prior to performing the experiments, participants roughly planned out the crafting process in their minds. This is evident from participant B's notes from the experiment (refer figure5 ,Appendix), where she notes the important steps in the making process; Participant C refers to the film record of the making process over and again repeatedly to identify the 'steps in making'. (refer figure 6, Appendix)
- For all the participants, the quality of the 'test tube' part of the object improves, or at least stays consistent with the quality achieved in Object 1. That is acquired learning.
- For object 1, the third attempt at crafting, without the use of measuring instruments does not generate any conclusive results with respect to developing the ability to sense measurement through repetition.
- For object 2, Performing the third attempt on the day after the first two attempts did not seem to significantly influence the quality of the object . Hence, one cannot infer from this observation , whether a time gap influences results due to space for making associations and analogies.

Notes: For detailed observations made during the experiment refer table 1, 2 and 3 in appendix for field notes.

Results

Object 1; test tubes

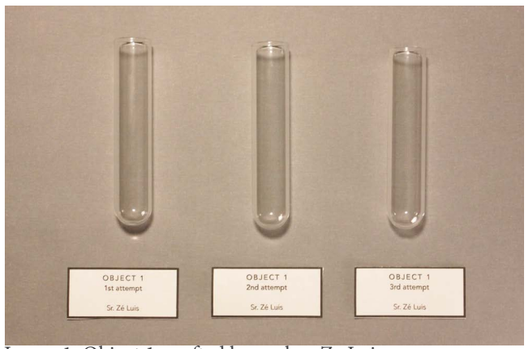


Image 1: Object 1; crafted by senhor Ze Luis

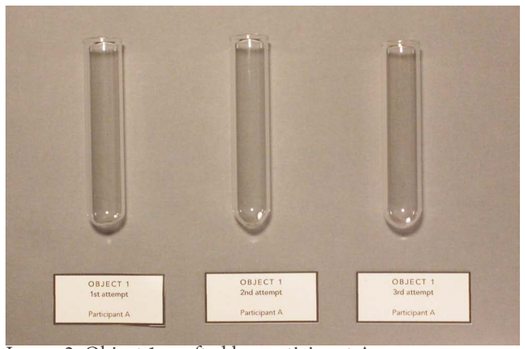


Image 2: Object 1; crafted by participant A

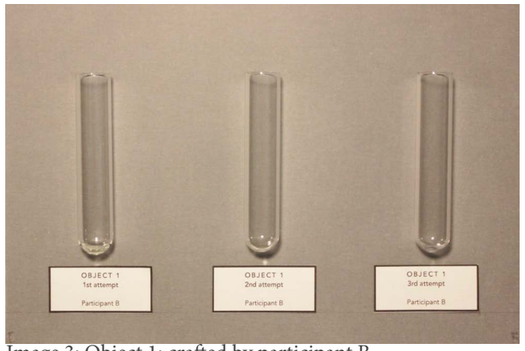


Image 3: Object 1; crafted by participant B

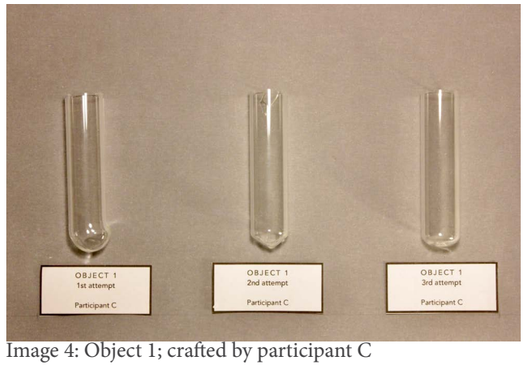


Image 4: Object 1; crafted by participant C

Object 2; Conversion reaction and receiver tube

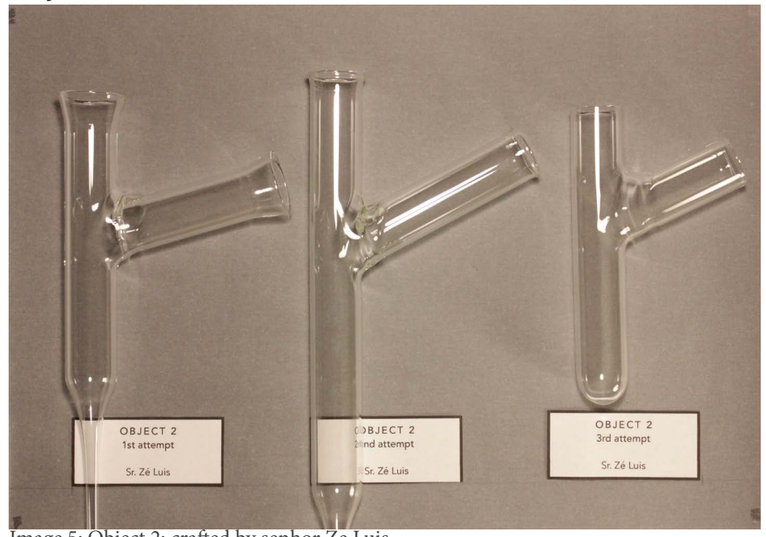


Image 5: Object 2; crafted by senhor Ze Luis

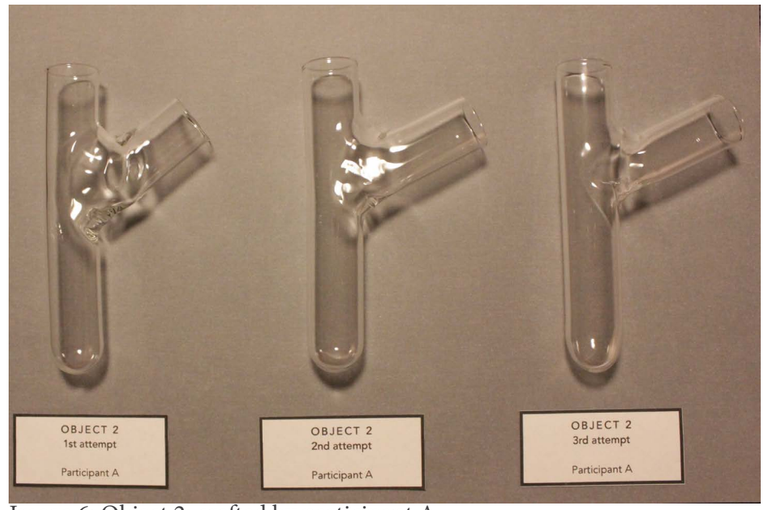


Image 6: Object 2; crafted by participant A

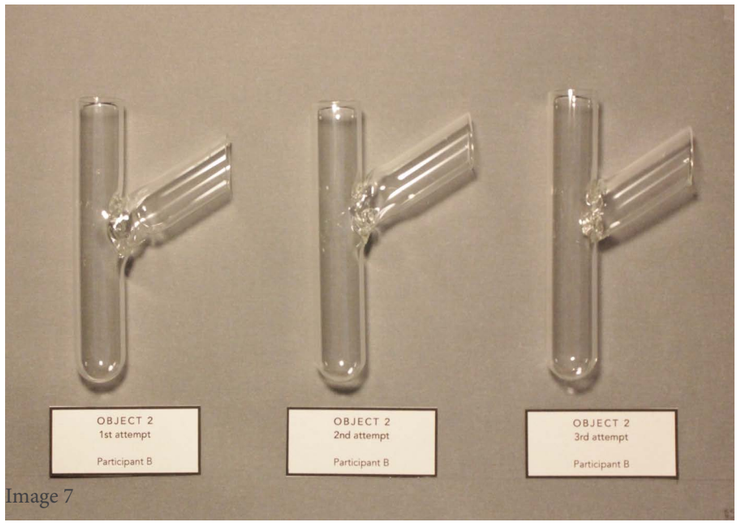


Image 7

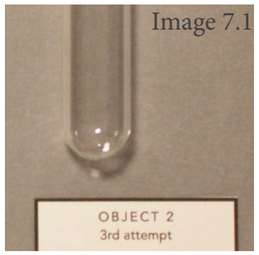


Image 7.1


Image 7.2

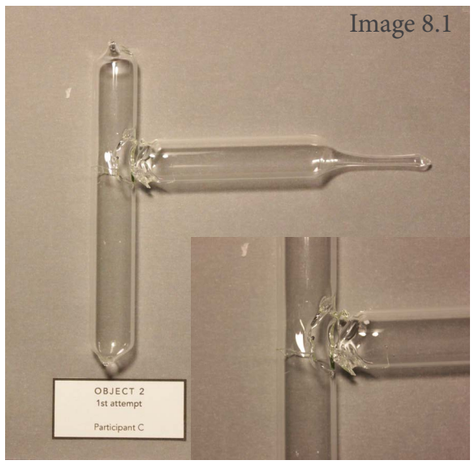


Image 8.1

Image 8.2

Image 8.3

Image 7: Object 2; crafted by participant B

Image 7.1: Object 2; crafted by participant B, attempt 3, test tube detail

Image 7.2: Object 2; crafted by participant B, attempt 3, showing the fusing details

Image 8.1: Object 2; crafted by participant C, attempt 1

Image 8.2: Object 2; crafted by participant C, attempt 2

Image 8.3: Object 2; crafted by participant C, attempt 3

Object 3; Interlinking squares

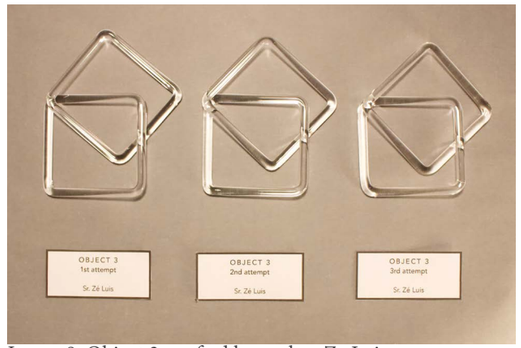


Image 9: Object 3; crafted by senhor Ze Luis

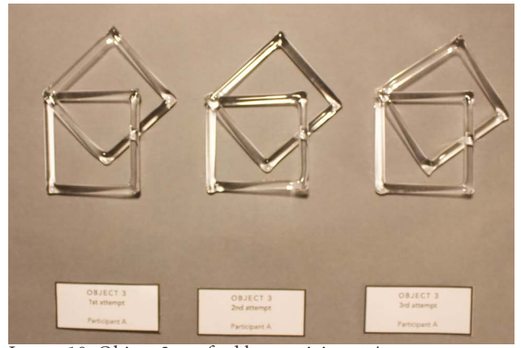


Image 10: Object 3; crafted by participant A

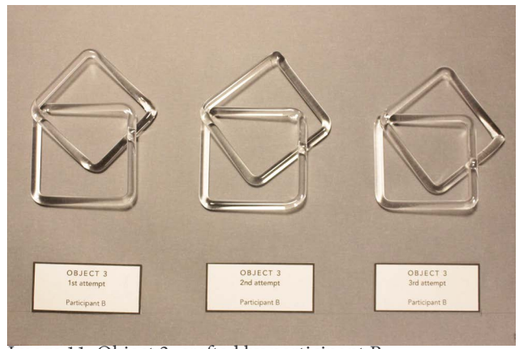


Image 11: Object 3; crafted by participant B

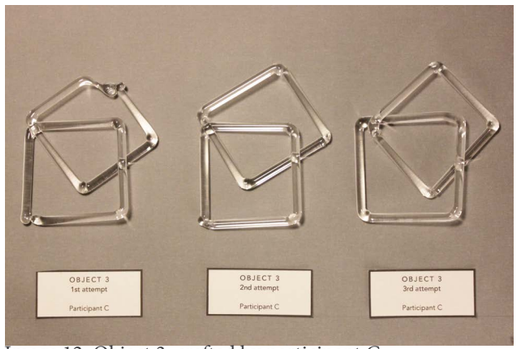
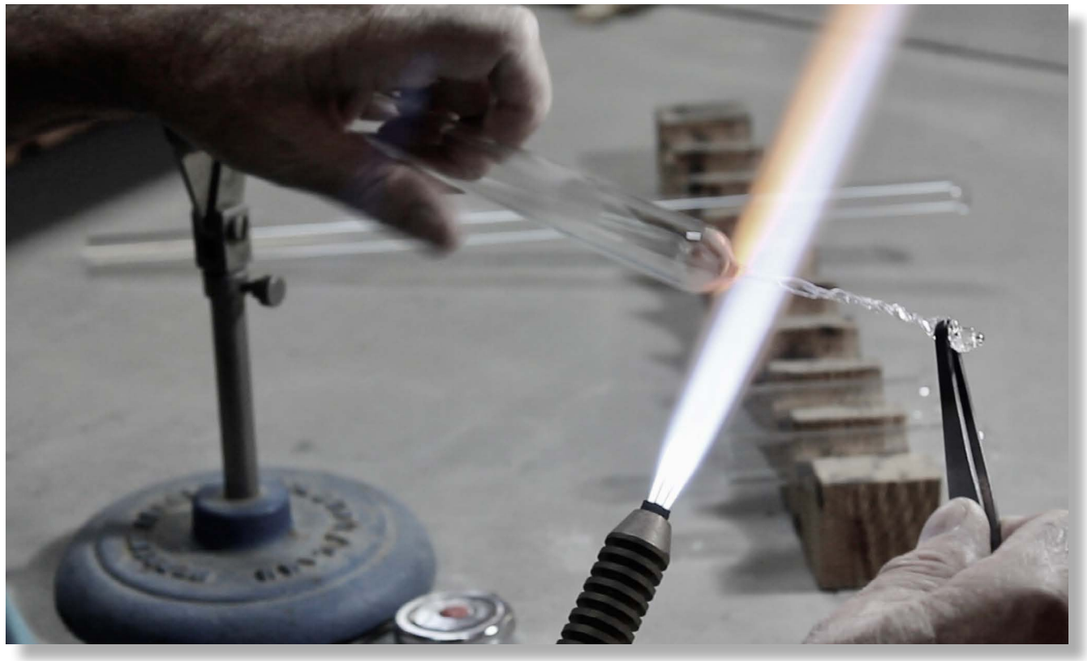


Image 12: Object 3; crafted by participant C



Discussions

I set out to understand the similarities between crafts and science, but I believe I discovered and learnt about a lot of essential aspect of the crafting process .This experiment was a vehicle for me to develop an understanding of what 'skill' is, what tacit knowledge is, how we learn a craft, and how crafts involve thinking?

My experiment to explore the similarities between crafting and scientific method have also been inspired by what Pamela Smith, a professor at the history department at the Columbia University said in her book,"The Body of the Artisan". She writes about the conventional opposition between " supposedly rote and unscientific approach of craftsmen and 'the experimental method' of the new experimental philosophers or 'scientists'. She states, 'the research methods long used by craftspeople were foundational to the professional bodies of modern science that emerged in the seventeenth century such as the Royal Society in England and the Académie Royale des Sciences in France.'[Adamson, 2018]

This section is divided into three parts - 1. The experimental design 2.What I learned about craft 3.The similarities and differences between crafting and science,

1. The experiment design

The aim of this experiment was to look for the fundamental features in crafting that may have similarities to the scientific method of investigation. However, as a novice, understanding and recording in text, what I witnessed in the crafting process, was not easy. To explain the challenge better, I quote Sennet, "Craftswork establishes a realm of skill and knowledge perhaps beyond human verbal capacities to explain; it taxes the powers of the most professional writer to describe precisely how to tie a slipknot". For me the challenge here was to observe and identify the essential features in the crafting process (through the process of borosilicate equipment making) that I could then compare with the scientific method of investigation, to see if they are similar in any ways.

My experiment design draws immensely from the scientific method. Taking from the practice of scientific experiments, controlling the variables in the crafting process (i.e. materials, access to the same set of tools, and the use of same torch), helped to cut down a lot of peripheral information. It helped me to organise the information that I was observing in the crafting process. When I now consider what the benefits and drawbacks of this 'experimental design' are, I realize that this process helped me to look at crafting close-up, and observe it in parts.

The film record

The reason why I chose to film the making process of the three objects used in the experiment using a subjective camera view is because I believe a film record will be comparatively unbiased as opposed to a written document. A video will help to bring to light the subject's point of view in the making process. Also it may cover any shortcomings or pitfalls in writing, which might affect the reproducibility of the object.

2. What I have learned about craft

The following is a discussion based on my observations from the experiment.

Due to the limitations posed by the current COVID- 19 pandemic ,I did not have a sizeable number of observations to draw very conclusive results from, but believe that the observations I've made can be interesting points for further investigation.

In crafting, there is often more than one possible process to reach a given end result. It is subjective to the maker. The process that we choose to craft an object is based on a number of factors, e.g. the relative level of our skill, our experience, the tools available, the material, the emotional state of the maker , time..etc. For all three of the objects chosen as the models to be reproduced in this experiment, each participant followed a different process to make it. Improvisations were made, alterations to the crafting process they saw in the records.

I observed , in crafting how important it is to be aware of the total productive situation. "Koestenbaum's observation is worth remembering when thinking about craft, for most type of making involves small, discrete actions. Together they accumulate into the form. Success comes from the coordination of these micro-events, the way they cohere either through repetition or meaningful variation. This is also how one learns a skill."[Adamson,2018]. So, the final quality of the outcome would depend on how well the different parts of a crafting process are executed. For example ,the possible reason why participant C, made considerably shorter test tubes than specified, even though having a great perspective sense of measurement, is because she was not familiar with the measuring device she was using. Another reference to the argument is that participants A & B felt that in order to craft the objects , to serve their function full capacity, it was crucial for them to know the required functionality of those objects, and in addition, to be able to consult technical drawings. Hence, information about the purpose of the object for them is an important part in the total productive situation of crafting.

A common observation in the course of my experiment is that the third attempt at making the objects, in the case of all participants, was better than their first. This is probably because with each successive attempt, the participants gained a better understanding of the whole productive situation, acquiring greater knowledge and developing skills This also indicates that repetition is essential to learning a skill ,and that tacit knowledge develops from the embedding of skills[Sennet, 2008]

Another interesting observation was that for all participants when crafting object 2,, the quality of the test tube part of the object , improved or at least stayed consistent with the quality achieved in the previous experiment of crafting object 1. This indicates that learning and awareness is permanent when acquiring a skill. And that on repetition, we start to embody skills which eventually become tacit knowledge.[Sennet, 2008]

In the process of learning or practicing a craft, we accumulate a mental record of techniques , tricks, ideas for crafting acquired by observing others at work. Glen Adamson, the author of the book 'thinking through crafts' calls this a mental archive, from which ideas can be called up at will, instantaneously and even subconsciously ." One such observation was the example of senhor Zé Luis finding the right technique to craft object 2. two failed attempts at crafting it, in the third (successful) attempt, the form used was inspired by tools that senhor Zé Luis uses for making complex scientific objects.

When we craft, we may be planning out decisive moments of the process in our heads, prior to engaging in the act of crafting. By decisive moments I mean points in the crafting process when the object transforms significantly. This is evident from the following observations - On questioning participant A , if he thinks of the process beforehand,- Participant A states that he looks at the drawing and has some thoughts and ideas ,and then he moves ahead with the execution. Participant B, prior to crafting object 2, while watching the video recording, made notes of the 'decisive points' in the making process. [refer fig 5, Appendix 1]. Participant C in a similar fashion referred to the videos over and again, attempting to identify points at which the object transforms[Also refer fig 6. Appendix 1]

3. The similarities and differences between crafting and science

As I began to compare my observations in crafting to the scientific methods of investigation, I discovered similarities as well as differences. I used the research cycle as a comparison for the discussion.

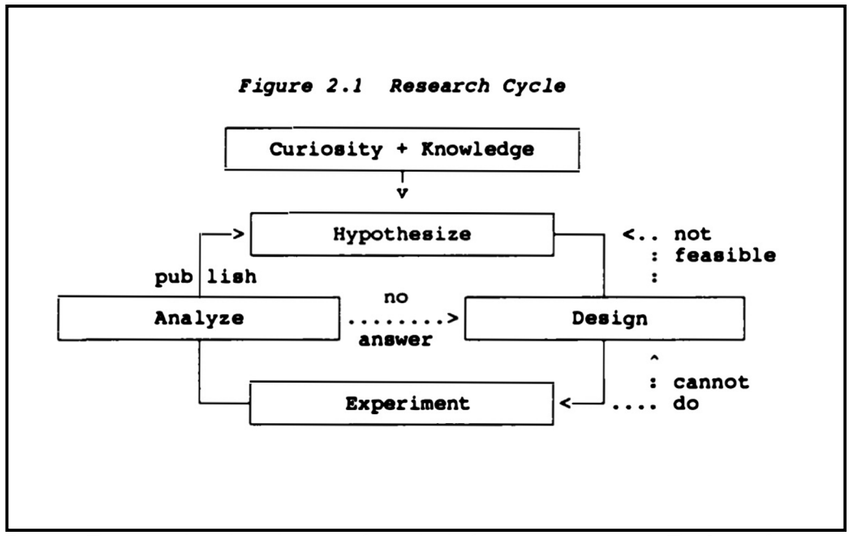


Figure 1: The research cycle in the scientific method of investigation; source: The Scientific Method and Conservation Research,GCI Scientific Program Report

Does crafting, as does scientific method, start with curiosity?

A scientific process of investigation starts with an observation or curiosity. This may not always be the case with crafting. Yes, one may start with the curiosity to explore a process, a material or a question, for example, 'how can I make this chair more comfortable to sit on?". But one can also craft starting from a drawing or an idea, which may not be the product of their own curiosity or observation. For example, in the case of my experiment, the objects were crafted from a technical drawing. One can craft an object simply for the sake of it. As Sennet in his book 'The craftsmen' states, "Craftsmanship names an enduring, basic human impulse, the desire to do a job well for its own sake". In a craft like the borosilicate scientific equipment making process, one usually starts with a drawing or a set of instructions from the user. To conclude, point of departure for scientific method of investigation and crafting could be different.

Do we generate a hypothesis in crafting ?

In a scientific method, a hypothesis is an assumption that is tested for its validity through experiments. It is a statement that can be supported or refuted through carefully crafted experiments and observations. A scientific hypothesis is a tentative answer to a question—sort of an explanation on trial.

In my opinion crafting does not start with a hypothesis. Instead, what it starts with is a sketch of the decisive moments in the making process. And then it is about constant anticipation of the next steps in making. Richard Sennet in his book 'The Craftsman' explains this idea in detail by describing glass maker Erin O' Connor's experience of learning to blow the Barolo Goblet. He states,"To work better , she discovered, she needed to anticipate what the material should become in its next, as-yet non- existent, stage of evolution. Her instructor called this simply "staying on track"; she, rather more philosophically minded, understood that she was engaged in a process of "corporeal anticipation", always one step ahead of the material as molten liquid, then bubble, then bubble with a stem, then stem with a foot. She had to make such prehension a permanent state of mind, and she learnt to do so, whether she succeeded or failed, by blowing the goblet again and again."

An observation of anticipation during the experiment, was when Participant A , while crafting object 2, exclaimed, "once I realize the hole is too big , I would throw out the object anyway. The hole or cavity being referred to here is the step before fusing another glass test tube to the cavity.

Analysis in crafting and scientific method of investigation

I believe analysis is as important to crafting as it is in scientific experiments. In crafting, analysis takes the form of reflection and self - critique, which are critical to improving one's skills. Illustrating this is the example of senhor Zé Luis crafting object 2. After 2 unsuccessful attempts at crafting the object, he clearly stated, "it is not the right way to make", and based on reflection on his previous choices in making, he proceeded to make the object(successfully) following a different method . Analysis and reflecting upon one's work is a constant practice in crafting. If one looks through the videos of the participants crafting the objects, one finds numerous instances of the participant stopping to judge their work, and based on their judgment, deciding on the next step(s). In crafts it is a very closed and tight cycle of constant analysis and action. This it seems to me, is unlike a scientific experiment where analysis is done after the experiment is performed. Craft by contrast is immediate. The following text from the book "Fewer, better things ", best elucidates the nature of this feedback loop that analysis in crafts generates, " craft is a two way street: As you shape the material, it shapes you right back. You are learning the process the whole time you are engaged in it."[Adamson, 2018]

If we compare the tools of analysis in crafting and scientific investigations, we observe that crafting heavily relies on bodily sensory perceptions. We may measure weight by heft, judge colour by eye. Whereas in scientific investigations, we need to use technology as an extension of our senses. In order to precisely analyze inputs from experimental observations. we use precision measuring scales to weigh, a spectrometer to precisely identify colour by its wavelength, because they have to be understood universally, there cannot be subjectivity in scientific investigations. In crafting an object, there is no need to be understood in the same manner by everyone.

Conclusions

This document is a compilation of my learnings till now. Understanding crafts, the nature of crafting and the commonalities between crafting and the scientific method of investigation, is a study for a lifetime. For now, the time was insufficient and the subject and all its variables too vast to reach any firm conclusions . In addition, the challenges and limitations imposed by working during the Covid pandemic hampered my productivity . However, this experiment was a learning opportunity for me to encounter and understand essential aspects of and the vocabulary used in crafting.

Considering the similarities and the differences between science and crafting that seem to me to have emerged from this study I think that their differences may be more consequential than their similarities. Crafting may not necessarily start with a question or curiosity , one may engage in crafting just for the sake of it. Also Craft is as much about thought as it is about action.

In crafts, we rely a lot on our instincts. Sometimes we undertake an action because 'it feels right'. To craft is as much about the body as it is about the mind. In a scientific method of investigation it is important to be able to explain and to defend all our actions and steps using words and mathematics, because scientific investigations must be understood and valid universally. But crafting heavily relies on bodily sensory perceptions, it is often difficult to explain in words .

To learn a skill, is an effort to develop a coordination between thinking and execution. The greater the skill, the better will we be able execute what we have in mind. "Skill is trained practice"[Sennet 2008]. Repetition is essential in order to develop a skill, and tacit knowledge develops from the embedding of skills. This is when actions become instinctive, when they are so habitual that we don't have to think about them. Hence, tacit knowledge comes from the skills that we have embodied.

Tacit knowledge unlike explicit knowledge is hard to share, it makes sense only to the maker ,because it's the way they put together everyday moves and actions, the gathering and assimilation of information which is individual to the maker. Interestingly, tacit knowledge can also be found in works of great researchers. As Sennet in his book explain it, "The same thing has been true in scientific labs run by idiosyncratic geniuses; the master's head becomes stuffed with information only he or she can see the point of. That is why the secrets of the great physicist Enrico Fermi a great experimenter can't be fathomed by pouring over the minutiae of his lab procedures." It is how we put together information, sensory experiences, skills, thoughts and bring it into action. In the end I have come to see tacit knowledge as one of the elements common to crafting and the scientific method of investigation.

The very process of 'crafting' this experiment, attempting to record and understand crafting, was in itself a huge learning process. I gained an understanding of how to reason my decisions in an experiment, to categorize data, and to plan and execute an experiment even when the subject of study produced results that weren't very pronounced ,or licensed any far-reaching conclusions. The data gathered about crafting and crafting processes wasn't all black and white. Large parts were grey, it was challenging to categorize and understand such data. There were mistakes made, , if I conducted such an experiment again, there were some points I'd now know how to improve on. Nonetheless, I am now sure that as a result of designing and having conducted this experiment, I now know a great many things more than I knew before I started.

Comparing craftsmanship and scientific endeavor, has brought me more both experience and understanding, revealed important details, and improved my ability to express abstract ideas . The comparative study of crafting and the scientific method of investigation, also helped me to discover some new and important aspects of crafting.

In future to further the study of identifying commonalities and differences between crafting and the scientific method. I would include results from a larger number of observations with more variations in skill and experience. Additionally, I think it would provide insight to include in my investigation, interviews with both craftsmen and scientists in situ, talking about their practice as they demonstrate it in their workshops or laboratories.

There is still a very great deal to discover about science and crafting before I have really figured out the nature of craftmaking I first witnessed years ago at Mr Tincer's workshop in India. Among the things I will now go home with from Vicarte, are the tools to better understand crafts back home, I feel much better equipped to study them now.

Thesis at the time of COVID-19

The reason I wish to include this section is because eventually as things get better in this world (cross my fingers), the memories of these trying times will slowly fade away. I want to remember the contribution of all the volunteering participants in my investigation who performed the experiments, following difficult safety procedures, as best they could ,and risked their personal safety to help with the experiment. For safety reasons, the freedom to move around Vicarte curbed, with limited access to workshops, compounding the difficulties. Completing my thesis at such a time was a serious test of resilience for me.

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Appendix

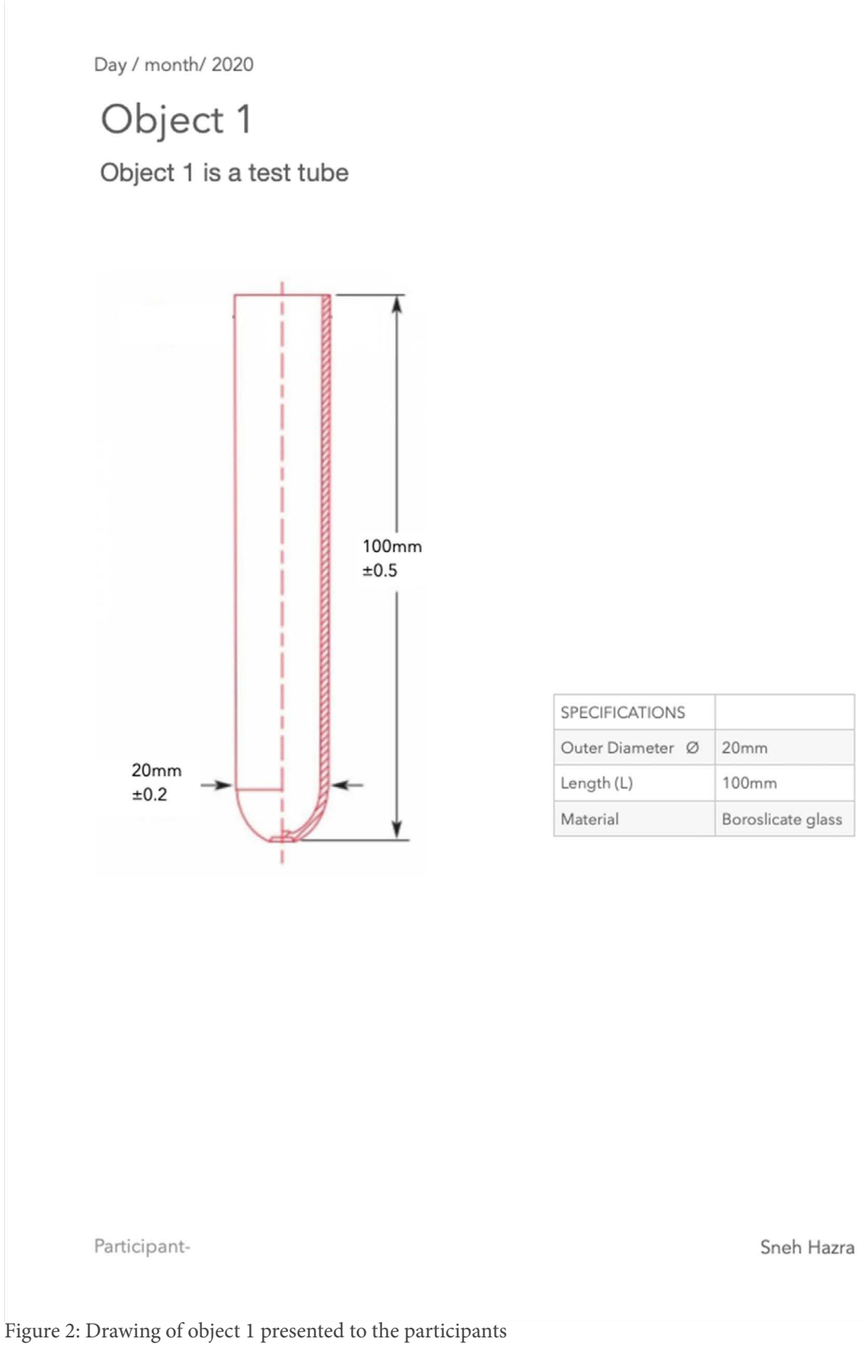
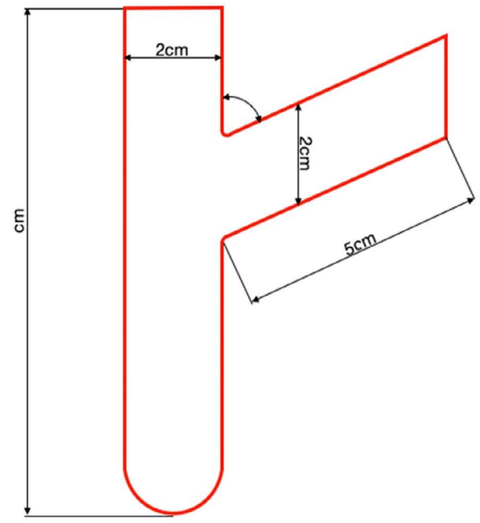


Figure 2: Drawing of object 1 presented to the participants

Day / month/ 2020

Object 2

Object 2 is a combination reaction and receiver tube. It is a scientific lab equipment.



Participant-

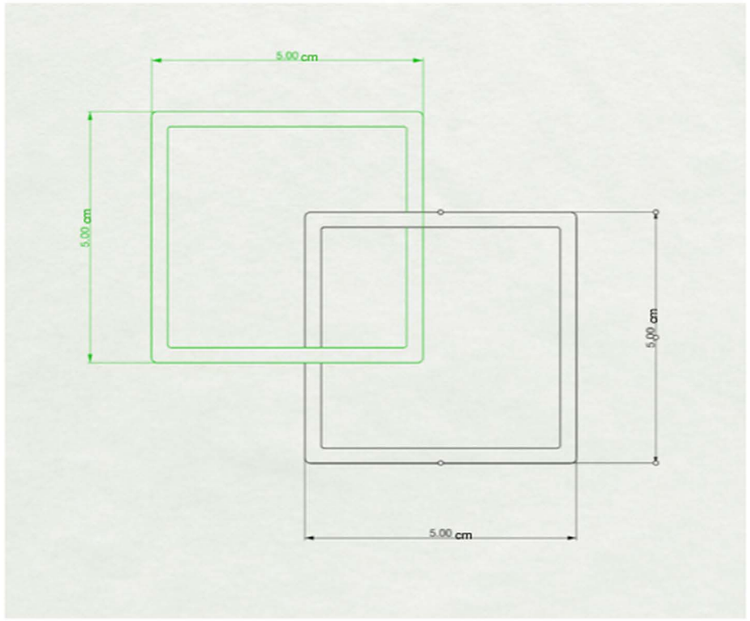
Sneh Hazra

Figure 3: Drawing of object 2 presented to the participants

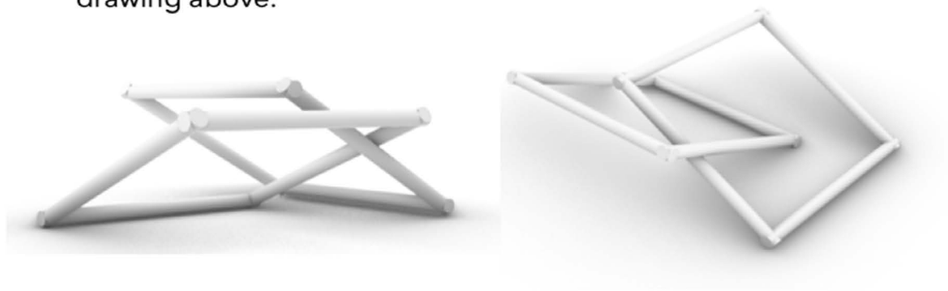
Day / month/ 2020

Object 3

The interlocked squares



Object 3: reference views, measurement as mentioned in the drawing above.



Participant-

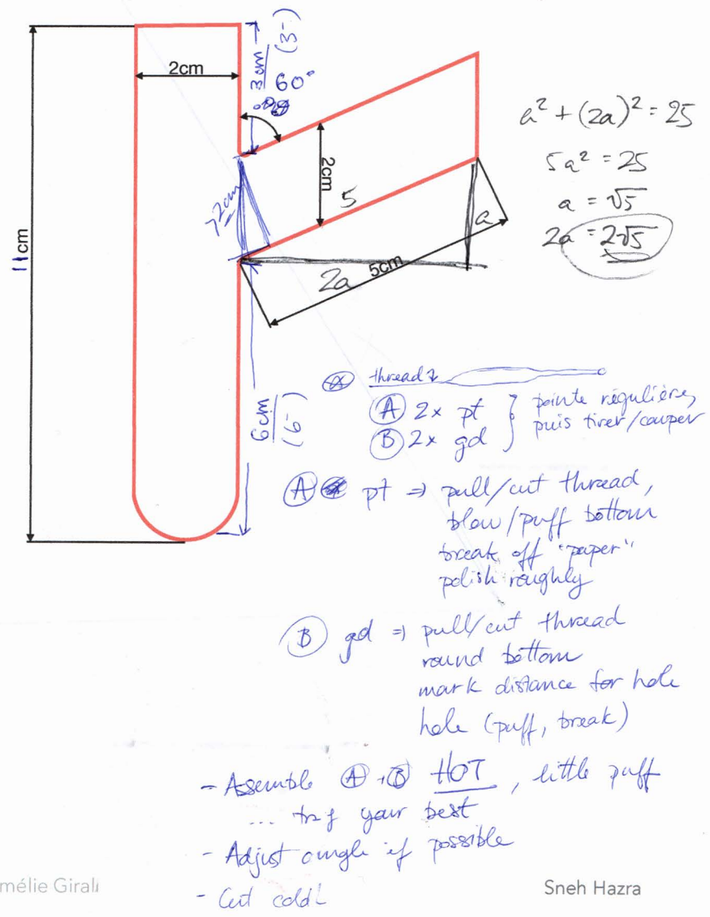
Sneh Hazra

Figure 4: Drawing of object 3 presented to the participants

7th October 2020

Object 2

Object 2 is a combination reaction and receiver tube. It is a scientific lab equipment.



$a^2 + (2a)^2 = 25$

$5a^2 = 25$

$a = \sqrt{5}$

$2a = 2\sqrt{5}$

Participant B - Amélie Girali

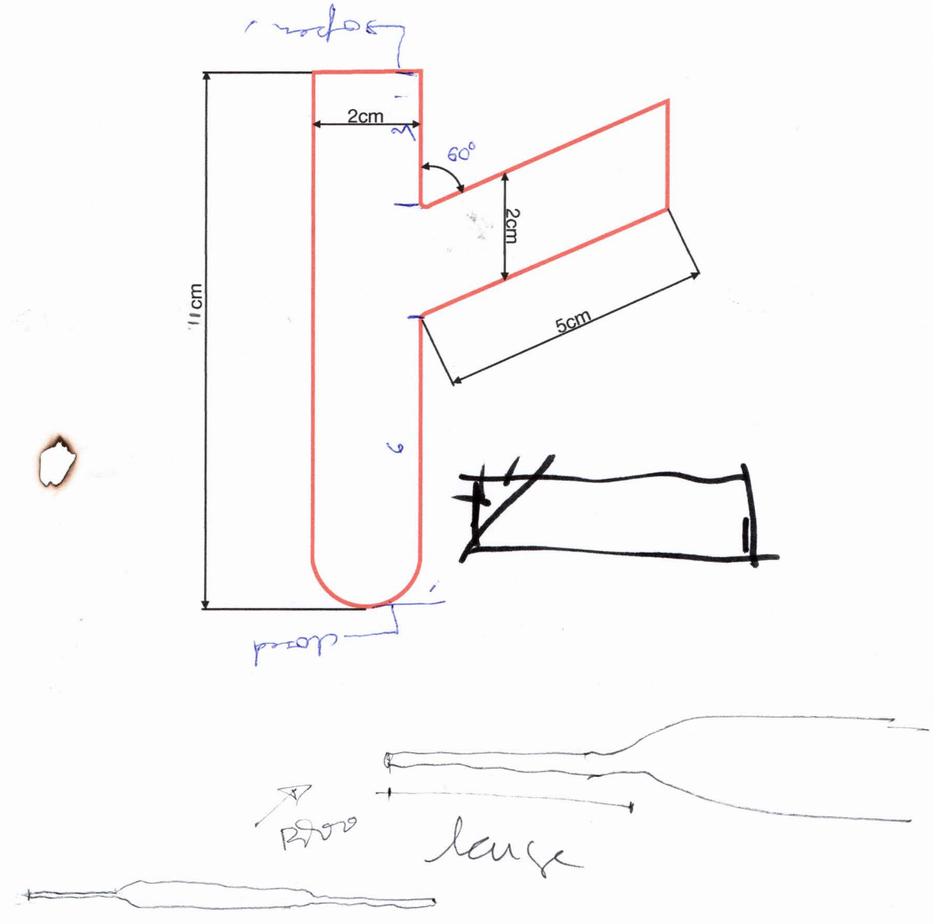
Sneh Hazra

Figure 5: Participant B's notes for crafting object 2

October 2020

Object 2

Object 2 is a combination reaction and receiver tube. It is a scientific lab equipment.



Participant C-Rozze Dominggues

Sneh Hazra

Figure 6: Participant C's notes for crafting object 2

FIELD NOTES- Object 1; test tube

Participant	Size	Form	Important notes on process	Participant's insights	Reflective information
Sr. Zé Luis	• The first and the second attempt are 10 cm. The third attempt is 9.5cm. • The variation in length is negligent	• The quality of uniform thickness improves in the 2nd attempt and stays consistent in the 3rd attempt. • The ends have a well rounded form • The test tube rims are well finished. Clean cutting and sanding	• Used a 'knife'(a scoring edge with a handle) to score the glass pieces • Demonstrating improvisations- using an alternative way of fusing the ends by a process byproduct - think long threads of glass, instead of using tweezers. • Cold working- Cutting on the saw, without a jig. Measurement marked prior cutting. • Finishing: melted down the sharp edges on the flame manually.	• Sr. Zé Luis said the he had never made test tubes with his own hand as test tubes are made industrially in masses.	• The quality of the object improves from the 1st attempt to the third.
Participant A	• The 1st and the 2nd attempts are 10 cm. The third attempt made without the use of measuring instruments is 9.5cm. • The variation in length is negligent	• 1.The quality of uniform thickness improves in the third attempt. • In the first and the second attempt the ends are slightly pointed and off center. The third attempt has a circular and 'on - center' end. • The test tube rims are well finished. Clean cutting and sanding	• 1. Using a charcoal deposit over the glass pieces to avoid thermal shock. • Used the 'pulling points' method , seemed to be inspired by the technique used in artistic flame work and the glass blowing process • Cold working- Cutting on the saw using the jig set at 10cm. Finished the test tube rim by sanding . • Finishing: Used the Lathe to shape the ends of the test tube in the final stage of production. Using a graphite tip to roll down the edges.	• Would choose the process of production based on the utility of the object, i.e if the participant was aware that the test tubes were to be used over bunsen burners he would put more effort into creating walls of even thickness. His decision making is also based on materials being used like "Borosilicate is a forgiving material" hence flexible to work with. • The maker personally feel his third attempt is the best • The maker believes, since there is a need for accuracy in this particular project, he needs to have an awareness of margin errors, during sawing. He needs to know how the saw blade cuts , whether it gives clean cuts or it chips out and needs additional sanding process to sand away the large irregularities • On the nature of crafting, Participant A states ,"The craft is like playing a musical instrument, physical dexterity as well as thinking is involved.	• The quality of the object improves from the 1st attempt to the third. • To the drawings were inadequate to convey the information about the purpose of the object, which would influence the form. For example The participant wanted to know how the test tubes will be used on a burner or otherwise, in order to craft the objects in the way they would cater to the intended use of the objects
Participant B	• The first attempt is 10.2cm.The 2nd and the third attempts are 10 cm. • The variation in length is negligent	• The quality of the object improves from the 1st attempt to the third • The first attempt has a very thick bottom. The quality of uniform thickness improved in the second attempt ,however deteriorated in the third attempt. . • The rounded ends are slightly pointed and of the centre. • The test tube rims are not well finished. Chip occurred while cutting at the saw.	• All the three attempts were made using processes that slightly differed. The processes used by the participants were improvisations based on Senhor Ze Luis's technique, however improvised to suit one's skill, experience and comfort. • Found the 'score and break method' challenging, hence improvised the process suiting her skills and used the saw to cut the initial pieces. • Participant B felt preferred the 'punty method' to close the shapes,, a more familiar process to her ,which she learnt in her formal training. • Cold working- Cutting on the saw using the jig set at 10cm. Finished the test tube rim by sanding • Finishing: melted down the edges on the flame manually.	• Preferred , felt more comfortable with the 'punty method', even though required an extra operation.	• The quality of the object improves from the 1st attempt to the third. • Participant B felt the needed more information about the purpose of the object to craft it better.
Participant C	• The first attempt is 8.4cm The second attempt is 8.3cm. The third attempt is 8.4cm • The variation in length is <u>not</u> negligent	• The quality of object improves from the first attempt to the third. • The participant could not achieve uniform thickness as fusing the end of test tube was challenging for her. • Her skill fusing the ends of the tube improves with successive trials . 3. The test tube rims are not well finished. The second attempt has a considerable chip. The third attempt also suffered a chip at the saw but was corrected by sanding.	• 1. The technique takes from Senhor Zé Luis's process of making. The participant tries both the methods of fusing, using tweezers in the 1st and 2nd attempt, and a piece of glass in the third. • The steps are challenging and require multiple trial and errors. • Cold working - without the use of jigs. Marking measurement on object as a reference. Uses the small sanding disk • Finishing: The participant does not finish the edges by heating in the final step.	• Participant C asked question to understand the changes she was observing . For example "Why does the glass stick to the tweezers?"	• The quality of the object improves from the 1st attempt to the third. • The scale of improvement at successive attempts is greater than other participants. The points of improvement are fundamental skills like uniform heating, sawing. • The reason why even after having an acute sense of measurement, the test tubes are not the correct size is because the participant was not familiar with the tool of measurement she was using.

FIELD NOTES- Object 2; Conversion reaction and receiver tube

Participant	Size	Form	Important notes on process	Participant's insights	Reflective information
Sr. Zé Luis	• The third attempt matches the dimensions on the drawing with a negligent error margin of 3mm. • The first and second attempts were not completed due to technical problems posed by the process of making chosen	• The quality of fusing at the joining significantly improves in the third attempt due to change of making process. • The quality of the test tube part of the object remains consistent to quality achieved in the third attempt of object 1.	• For the first two attempts, Senhor Zé Luis was making object 2 based on a process used to craft the test tubes, However this process was not suitable because it required maneuverer too close to the flame. For the third attempt Senhor Zé Luis, inspired by a tool he uses, improvised the form. The process and the form he improvised is similar to the "pulling points' method used by Participant A and B to make the test tubes. • Cold working: Cold-working without jigs with measurement marked on the objects. • Finishing: melted down the edges on the flame manually.	• Sr. Zé Luis had seen this particular equipment but never seen the crafting process for the same nor had he crafted one himself.	• The improvisation of technique used in the third attempt was interesting. This improvisation is based on a tool Senhor Zé Luis uses[image no.] based on that he improvised the forms of the objects. This improvised process and the forms are similar to 'pulling points' method used in crafting by Participant A and Participant B.
Participant A	• All the observations match the dimensions on the drawing with a negligent error margin of 3mm.The error margin reduce with successive trial.	• The quality of fusing at the joining in the second and the third attempt is better than the first . • The quality of the test tube part of the object remains consistent to quality achieved in the third attempt of object 1.(that is even thickness and an 'on centre' bottom)	• 1. Participant A and Sr. Zé Luis's process of crafting was same. It involved making the corn dog form,or the 'pulling points' method. • Participant A also used other improvisations like patching holes (refer video) during the fusing process. • Cold working: Cold-working without jigs with measurement marked on the objects. • Finishing: melted down the edges on the flame manually.	• On questioning if the participant thought of the process beforehand - "I looked at the drawing, I had an idea. When I looked at the video, it confirmed my idea". The Participant stated that he essentially doesn't think of all the steps , he is familiar(from his art making practice) with these steps and finds them normal . • "Muscle memory develops when you do these things over and over again, I am relying on a tool box related to art making (to make scientific equipments) 3. "Once I realise the hole was to big (the cavity blown at the joint in the object)I would throw it anyway."	• Participant A uses the 'pulling points' method throughout the three attempts, essentially getting better at the same technique • Participant A improvised with the patching technique to make up for the lack of skill at the technique of fusing.
Participant B	• All the observations are close to the dimensions on the drawing with the maximum error margin being 5mm. The error margin reduces from the 1st attempt to the third.	• The quality of fusing at the joining in the second and the third attempt is better than the first. • The quality of the test tube part of the object has improved(on terms of the thickness at the bottom and centred bottoms) in comparison to the quality achieved in the second attempt of object 1.(that is even thickness and on centre bottom)	• 1. Participant B uses the 'pulling points' process of crafting object • Cold working: Cold working without jigs with measurement marked on the objects - Participant B initially set up jig but opted to work without one, as it hindered turning the object while cutting, which would cause chips. The participant improvised the cutting technique- using the half and half method to cut, to avoid chipping.	• Participant B states she can't think what process she would use to make the object if she had not referred the video.	• Participant B, improvises to work around limitations of skill. • Participant B improvised with the patching technique and other processes like cutting to make up for the lack of skill, experience.
Participant C	• The first attempt was not completed. The second attempt is not in scale. The the third attempt two of the four measurements are close the dimensions in the drawing.	• The fusing was not successful, the pieces broke in the process. The fusing in the second attempt is intact and the best of the three attempt. • The quality of the test tube part of the object does not remain consistent or improve to quality achieved in the third attempt of object 1	• Participant C was employing the 'pulling points' which she learned from the video, however the lack of skills and experience in flame working made it a very challenging process for the participant. • Participant C referred the videos many times prior to crafting.	• 1. Participant C states, "through this experience I learnt how not to do things". She essentially meant that she now knows the processes or steps that will not work in the making process • The Participant believes if the steps in the video were explained in words then it might have helped her better in her making process. • Also participant C felt the fusing process the most difficult of all the steps in making object • . Also the participant feels she is getting better making test tubes.	• Participant C improvises very little but attempts to imitate the process as close as possible from the videos. The process essentially is a learning process, developing a repository of experiences.

FIELD NOTES- Object 3; Interlinked squares

Participant	Size	Form	Important notes on process	Participant's insights	Reflective information
Sr. Zé Luis	• Measurements 1st set: 5.7x6; 5.8x5.5 2nd set: 5.8x5.5; 5.5x5.5 3rd set: 5.7x5.7; 5.7 • Ignoring the few mm of difference, all the forms are squares. However there is a additional length of 0.5 on all the attempts, on an average, indicating a shortcoming in the planning process.	• There is consistency in the quality in all the three attempts. • No visible joints, no creases at the vertices and nominal bubbles.. • The vertices are rounded	• Senhor Zé Luis used the simple heating and bending approach to craft the objects. 5 cm were scored on the glass rod as a guide. He used the tweezers and graphite tools to craft the objects . The reason why the average size of the squares is 5.5x5.5 is because the thickness of the glass rod was not accounted for.	• Most of insights from the discussion made with participant B were not relevant for the experiment.	• Even though the squares are bigger , on an average of 0.5cm. The forms are very close to being squares.
Participant A	• Measurements 1st set: 5.2x5.5; 5.2x5.3 2nd set: 5.2x5.5; 5.2x5.5 3rd set: 5.5x5.3; 5.2x5.5 • Even though the thickness of the glass rods were accounted for , 1 square in each set has a side measuring 5.5 cm.	• There is consistency in the quality in all the three attempts. • No visible joints, no creases at the vertices and nominal bubbles. • The vertices are distinctively close to the drawing. The edges are very crisp and sharp	• Participant A has prior experience of making these forms. Participant A took into account the thickness of the glass rod and created the squares using four different pieces heat fused together. • He also used the 'punty method'(attaching a glass rod to one vertex on the square to help maneuver better) to handle the squares with ease. In addition participant A, 'pulled' the corners of the squares, to make the forms sharp and close to the representation in the drawings.	• Participant A said that he has made these objects before.	• Visually, the form of the squares were closest to the drawing. Also having done the process multiple times before , helps the maker helps device solutions around limitations posed by the material and the forms. Comparatively the process that Participant A used allowed greater freedom of heating and manipulating the form
Participant B	• Measurements 1st set: 5.7x6; 5.8x5.5 2nd set: 5.8x5.5; 5.5x5.5 3rd set: 5.7x5.7; 5.7 • Ignoring the few mm of difference, all the forms are squares. However there is a additional length of 0.5 on all the attempts, on an average, indicating a shortcoming in the planning process.	• There is no consistency in the quality in all the three attempts. • The similarity in the size of the two squares in a set improves in the second and third attempt. 2.The joints are not obvious yet can be identified on close inspection 3. No creases and nominal bubbles	• Participant B also used the simple heating and bending approach to craft the objects. Participant B like her previous approaches drew a square to scale on the work table to allow handy reference of measurements . She used the tweezers and graphite tools as aid. The reason why the Squares are not 5x5cm, even though the glass rods were measured while crafting ,is because the thickness of the glass rod was not accounted for..	• Most of insights from the discussion made with participant B were not relevant for the experiment.	• Even though Senhor Zê Luis and participant B used the same process and tools to make the forms, The visual language is different so is the joint quality. This illustrates the role of skill and individuality of a maker.
Participant C	• Measurement 1st set: 5.5x5.5&5.5x5.5x6x5.8 2nd set: 5.7x5.5 & 5.7x6 3rd set: 5.8x5.5x5.5x5.8 & 6x6x5.5x5.5 None of the forms are squares as the participant	• 1. In the forms the third and the fourth side are longer, as a result of challenges faced while attempting to close the form. • The quality of fusing the ends together is better in the second and third attempt. 3. Formation of creases at the vertices due to uneven heating.	• 1. Participant C was finding it challenging to close the form. • Participant C only used the measuring instruments to confirm the length. • 2. Improvised but incorrect usage of tools.	• Most of insights from the discussion made with participant C were not relevant for the experiment.	• Participant C, being a beginner and with very little experience and skill in flame working, struggled with the use of tools. Using many tools in an attempt to maneuverer the material better. • Participant C improvised the technique to suit her skills by using two tweezers to handle the form. This improvisation is similar to the 'punty technique' that Participant A used, for the same purpose i.e to avoid being too close to the flame.

Online exhibition

Contents

DURGA

Online Exhibition
March 2021

Sneh Hazra

The online exhibition is presented in three parts.
The links contain videos with sound

Part 1of 3 https://indd.adobe.com/view/31d768dd-3447-46bc-a81a-4a24b92718f8
Part 2 of 3 https://indd.adobe.com/view/afb909cd-d0aa-496d-ae6b-43444496da8e
Part 3 of 3 https://indd.adobe.com/view/23d6e8ae-8167-42e3-8207-8909e5cb199f

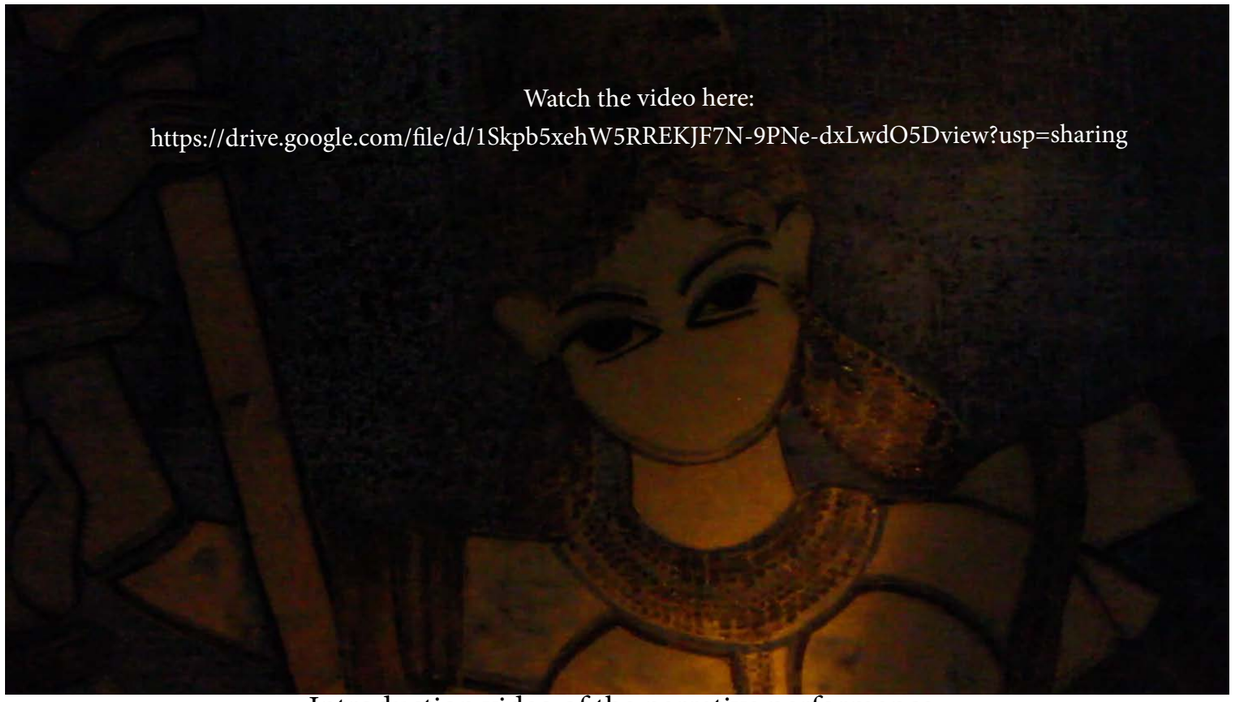
DURGA

Online Exhibition
March 2021

Sneh Hazra

Facing page:
Mahisha and Durga mid battle
Mica and enamel on float glass
30X30 cm, 6mm

Page 47:
Mahisha Vadha (The end of Mahisha.)
Mica and enamel on float glass
30X30 cm, 6mm



Introduction video of the narrative performance
The Video shows the ritual of drawing the eyes of the deity metaphorically brings it alive.

Introduction

Mythology and mythological stories are a significant part of our everyday life in India. I believe they are there to help us make sense of the world. Indian mythological stories often represent metaphysical ideas. Presenting complex truths of the world in simple and fascinating ways. Discovering and attempting to understand these hidden ideas and underlying social connotations interests me immensely. These stories are often interpreted in a contemporary context giving them relevance even today.

The object I made for my exhibition is called ' Durga'. It is a partition made in glass and bamboo that takes from the narrative traditions in India.
It draws from the concept of mobile shrines and accompanied performances such as the 'Pabuji ni Phad' and 'Mata Ni Pachedi' in India.
These mobile shrines are hand-painted cloths. These cloths are sometimes 5 meters long and depict the story of local heroes or deities. These stories are then performed with oral narration and accompanied music. The communities involved in the narration of these stories fold and carry these scrolls with them, setting them up in villages and towns they are invited to perform.

The subject of depiction is the story of 'Durga and Maishaura'
The story of Durga is mentioned in the Puranas. The Puranas are one of the significant scriptures in Hinduism. In these scriptures Durga is described as the powerful warrior Goddess who has time and again restored balance in this world and beyond by vanquishing powerful asuras. The word asura is close in meaning to the word demon.
The story goes as follows, Mahisha is a powerful shapeshifting Asura having gained the power of invincibility from the God of creation 'Brahma' he wreaks havoc in Triloka(the three worlds /spaces).
Mahisha with his army declares war on the Gods, overpowering the king of the gods Indra. In desperation, the gods seek help from Shiva, Vishnu, and Brahma (The gods of destruction, sustenance, and creation).
The Gods unite their energies to create the powerful warrior Goddess Durga. She is accompanied by her lion to battle along with Yoginis (female sages) and Ganas(the mythical creatures who accompany Shiva) as her army.
The fierce battle between Durga and Mahisha lasts nine days. Finally, on the 10th day, Durga vanquishes the shape-shifting Mahisha mid-transformation. Restoring balance in the three worlds.

Why a glass partition?
The glass partition reflects the containment and isolation that Covid 19 brought in. It was as if a glass wall was separating me from the world.
Here, the story of Durga and Mahisha made me reflect and raise questions about who is Durga and who is Mahisha in this Pandemic? Are we Mahisha or the Covid Virus? Who is Durga- nature or us.

Display 1: Objects in Daylight

Image 1: The glass partition consists of three panels

Image 2: A close up of the glass panels

Display 1: Objects in Daylight - reverse side

Image 3: The glass partition from the reverse side

Image 4: A close up of the glass panels from the reverse side

Display 3- Performance of ‘narrative of Durga and Mahisha’

The story is narrated in the ‘style of veneration’ or ‘Bhakti Rasa’ like in the traditional Indian narrative practices that accompany mobile shrines. In this style of recital, the story unfolds in context to the protagonist deity, here it is the warrior Goddess Durga. In traditional Hindu mythology, she is seen as an embodiment of ultimate power and energy in the universe.
The structure of the narrative is repetitive and cyclic. A new episode always starts with veneration to the Goddess. To explain, the pattern of the narrative is something like this: veneration - new episode - veneration - new episode - veneration
Parts of this narrative are translations taken from the 7th Century Hindu scriptures called the ‘Puranas’. Specifically from the ‘Devi Mahatmya’, (meaning “glorification of the Goddess”), which constitutes chapters 81 to 93.

Video of the narrative performance

Transcript of the performance

Supreme energy, the power that brings life to the universe. Victory to you!
You are the slayer of the powerful yet ill-minded, the havoc-causing demon- Mahisha. Who spent 100 years in Meditation. Balancing on one foot, in yoga, to please the God of creation -Brahma.

Victory to you Goddess, The embodiment of bliss.
You are the slayer of the powerful demon -Mahisha. Who having pleased the God of creation -Brahma gained a boon of invincibility, such that no man or God would be able to bring death upon him.

Victory to you Goddess, The manifestation of cosmic power. The slayer of the havoc-causing Mahisha, who along with a large army of demons, raged destruction across the three worlds. Overpowering the king of gods, the mighty Indra.
Oh! the shape-shifting Mahisha, turning from a buffalo to a tiger to a man to an elephant, disrupting balance across the three worlds.

Victory to you Goddess, who nourishes the three worlds, who engages in a battle with the asuras and vanquishes ills.
Your strength, even the king of the Gods -Indra is in awe. Indra, who having been overpowered by the shape-shifting Mahisha, approaches all other Gods to seek help restoring balance to the universe and vanquish the havoc causing Mahisha.

Victory to you Goddess, the slayer of the shape-shifting, havoc-causing Mahisha.
You are the embodiment of power. The Gods pooled in their energies and cosmic weapons to create you. Shiva grants you his trident, Vishnu his discus, Vishwakarma his ax, arming you for the epic battle.

Victory to you goddess, who lives in all beings as power of oneness in many. Armed with a sword, discus, conch, bow, arrows, slings, and mace, you are beyond high and low. You ride into battle on your lion with an army of Yoginis(female sages) and Ganas(the mythical creatures who accompany Shiva) and battle the ferocious, powerful, shape-shifting Mahisha. Victory to you, who holds the bow and arrow with grace and poise, you perform the war like a cosmic dance.

Victory to you Goddess, the embodiment of intellect. You are now Mahishasuramardini, meaning the slayer of demon Mahisha. You slew mid-transformation, Mahisha appears from the body of the buffalo as you thrust Shiva’s trident through him. You are soothing, you are fearsome, you are the primordial nature untransformed.

Victory to you now and beyond. You who is the supreme energy. May you protect the universe.
Salutations to you the goddess, who lives in all beings as the power of inner strength, as the power of hunger, as the power of intellect, as the power of patience. To that goddess who lives in all beings as power of oneness, who governs the five elements. Victory to you!

Part 2 of 3

60 | Display 4: Photographs of individual Panels

Display 4: Photographs of individual Panels

Note:

For all the images on pages 4 to 11
The images marked 'A' were photographed in sunlight with a white opaque background
The images marked 'B' are photographed with background lighting

A

B

'Mahisha in tapasya'
(meaning Mahisha perfoming meditation)
Mica and enamel on float glass
30X30 cm, 6mm

A

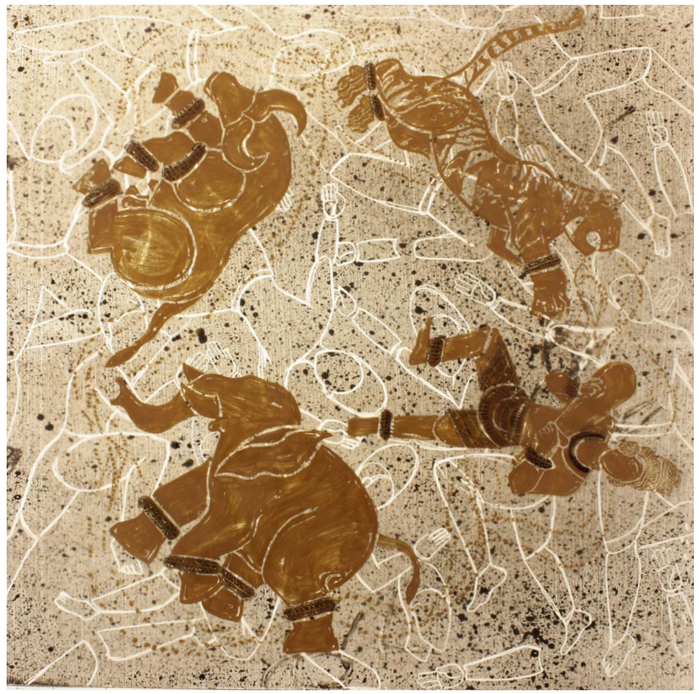
B

B

'Brahma and Mahisha'
Mica and enamel on float glass
30X30 cm, 6mm

A

B



‘Mahisha wreaking havoc in triloka(three worlds)’
Mica and enamel on float glass
30X30 cm, 6mm

A

B

‘The creation of Durga’
Mica and enamel on float glass
30X30 cm, 6mm

A

A

B

‘Shakti’
(meaning power)
Mica and enamel on float glass
30X30 cm, 6mm

A

A

B

Mahisha and Durga mid battle
Mica and enamel on float glass
30X30 cm, 6mm

A

B

‘Mahishasuramardini’
(Meaning the slayer of Mahisha the asura)
Mica and enamel on float glass
30X30 cm, 6mm

A

B

A

‘Mahisha Vadha’
(The end of Mahisha)
Mica and enamel on float glass
30X30 cm, 6mm

Part 3 of 3

Making - Materials and processes

Discovering Indianness.- the choice of materials

Through my works, I have also attempted to discover materials that possess an 'Indian identity in design. This question was often raised at my previous design school focusing on traditional Indian Crafts and at seminars at the business school IIIM- A.

Display 5- Working with Mica

Mica is a commonly found silicate mineral, available in various metallic glittery hues, a common ingredient in cold paints and cosmetics. Mica is available in the form of sheets, flakes, and dust and can withstand temperatures close to 850°C. I was drawn to it by its resemblance to gold. Gold(the metal) has been an integral part of Indian history. The color and the metal gold are a significant part of the Indian visual language. Gold still has a great significance in the lives of Indians. Hence, it seemed like an apt element to represent Indianness.

Mica has its challenges to work with, one of them being the formation of large air pockets (or bubbles)between sheets of float glass. It is preferable to cap mica inclusions between two sheets of glass as it easily dusts off post-firing. For this project, I used mica dust. I attempted to explore two processes of application. The first process involves dusting mica over an application of binding material(kiln safe water-based glues). The second process was making mica foil(like a gold foil) by mixing it with a binding agent (kiln safe water-based binding agent)

Video : working with mica, the different processes of application used for the project

Image 1: Discoloration of mica due to uneven application
Image 2: The formation of air pockets and the eventual burn off of Mica

Display 6- Painting with enamels

Each float glass panel has the application of enamels on both sides. The enamels help provide a background for the mica-painted images to stand out. Also, it helps create details such as the fabric, hair, and jewelry.

Display 7- Bamboo and concrete

Bamboo in India is a readily dispensable, inexpensive material. It is used to put up makeshift structures and the scrolls in narratives.
This project was my first attempt at working with bamboo. It is different than wood. Each bamboo pole is a hollow individual dried stem of bamboo grass, that varies in dimensions and linearity.

Display 8 - Inspiration and references

To create the images for the narrative I was inspired by the historic temple sculptures and relief work in stone from the South of India.
I have taken direct references from some of these sculptures. They are acknowledged below.

Image 1: Stone relief from Kailasnath Temple, Kanchipuram, Tamil Nadu, India
Image 2: Stone relief from Aihole Temple, Karnataka, India
Image 3: Stone relief from Mahabalipuram, Tamil NaduIndia

Display 8 - Inspiration and references

The Narrative tradition of ‘Phad’
In this passage the ‘Phad’ is referred to the painted cloth/Scroll and the performance of the ‘Phad’ means singing passages of the story in reference to the illustrations.
The mobile shrines like the ‘Phad’(painted scroll) are modular. The painted cloth is folded away once the performance is over. This is a fascinating design element to me. I have attempted to make the partition modular. The glass, bamboo, and concrete elements in the partition can be disassembled.
The illustrations in the ‘Phad’(painted scroll) are not in chronological order but in a synoptic order. Also in the performance of the Phad, there is no fixed chronological order to sing the passages. The performance of the Phad like a lot of other narrative traditions in India is participatory in nature. The reaction and interjection from the audience influence the narrative. For example, the events may be cut short or sung with flourishes on demand from the audience. Inspired by the participatory nature of these performances, I too, wanted my narrative to be flexible. Hence, the glass panels can be arranged and rearranged to how the user wishes to narrate the story.

The ‘Phad’ narrations usually happen in the dark of the night and the narrator illuminates the parts of the painted scroll with a lamp while narrating the story. The use of Mica in the glass panels helps mirror this action. The Mica in the glass panels glow and illuminate as light is shown upon it

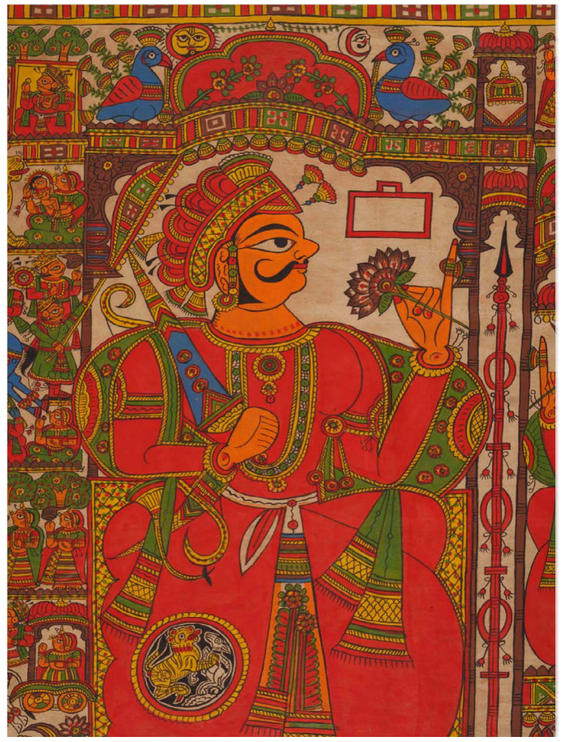
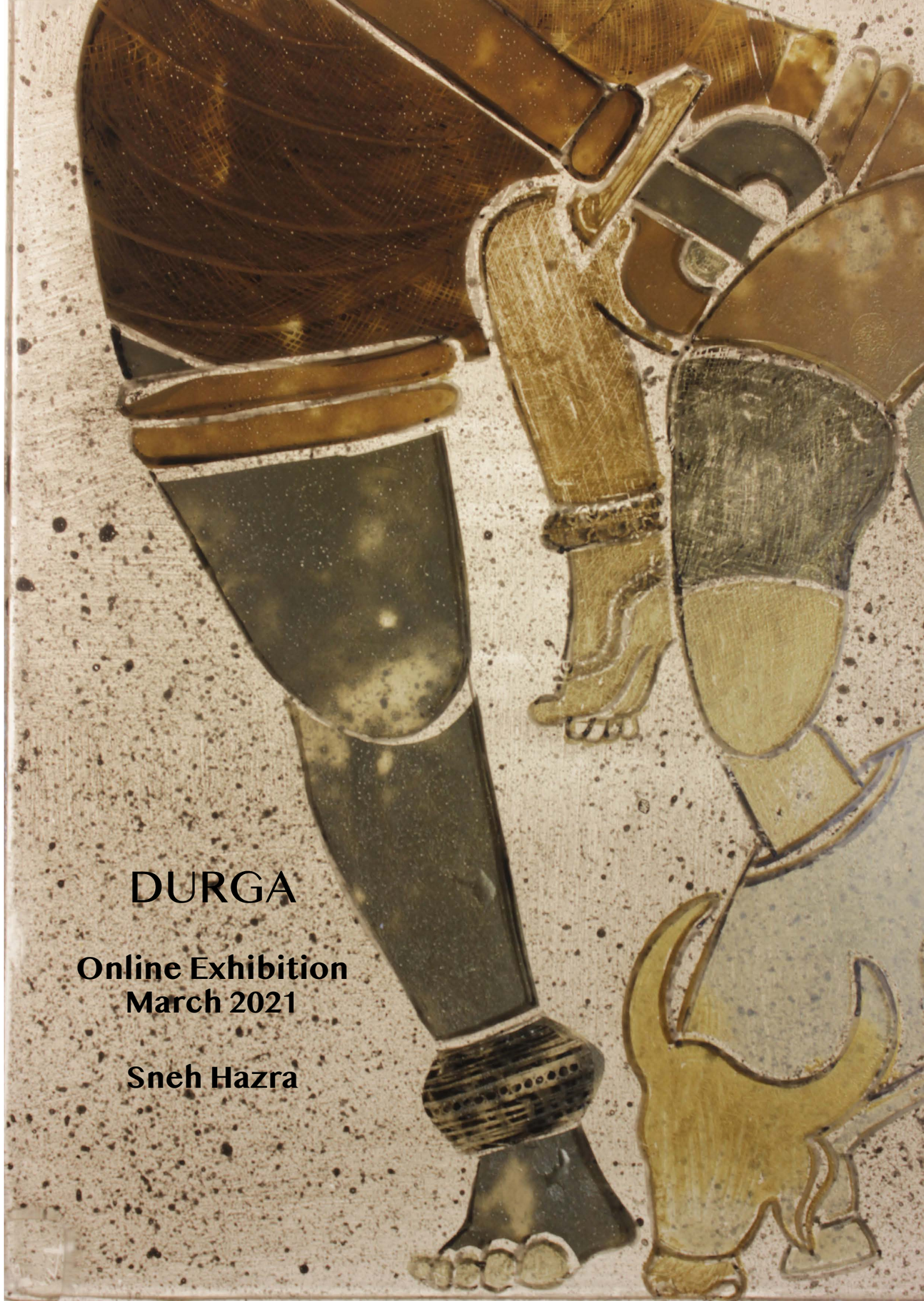


Image 3: Details of illustrations from the ‘Phad’
Image 4: The narrator using an oil lamp to illuminate parts of the story she is narrating
Image 5: The image of the protagonist deity is larger than the characters in the narratives, an element I have attempted to incorporate in my work.



CRAFTING AND SCIENCE

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