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## Studio jewellery processes for the post-cyber designer

Caru Smuts, *Cape Peninsula University of Technology*

Monica Di Ruvo, *Cape Peninsula University of Technology*

### Abstract

*The cyber revolution has emphasised the dialogue regarding perceptions of value between the mechanically produced and the handmade jewellery piece. The application of modern digital design technology with traditional methods of working by hand in the studio jewellers' practice raises questions of authorship, authenticity, and artisanship.*

*Literature reveals that in the digital age, technology is developing at a rapid pace, and that in the future manual jewellery design and manufacturing processes could be eliminated completely. To date however, there is no jewellery making process that excludes manual labour entirely. The rapid development of technology could impact the future sustainability of the studio jeweller in their ability to remain viable in terms of price, time, material consumption, variety and complexity of design afforded by digital processes. In turn, this has direct bearing on the design curriculum at higher education institutions preparing graduates with the necessary skills to enter the workplace.*

*In this research, the authors aim to explore the incorporation of digital design technology into the studio jewellery design and manufacture process of bespoke jewellery. The research aimed to develop a basic framework to find the balance between technological advancement, mass production, the continuity of tradition and the function of the studio jeweller in the jewellery industry.*

*The study was conducted in the greater Cape Town area using a participatory action research method based on an iterative reflective cycle. Participatory action research allows for the parties most affected by changes in the industry to participate in finding a proposed solution. The findings of the first cycle are presented in this paper and a conceptual framework is proposed which will inform future research and jewellery design curriculum development. Such an updated framework will assist studio jewellers to consider a wider range of technologies while retaining the authenticity of traditional bespoke jewellery in a post-cyber society.*

**Keywords:** Digital jewellery design, jewellery design education, jewellery design processes, studio jeweller processes

### Introduction

Jewellery design has been defined as a discipline where specialist knowledge and practice are applied to the conceptualising and making of jewellery products (Newman, 2015). The essence of the studio jeweller's craft is the design and manufacture of bespoke pieces of jewellery underpinned by the individual design aesthetic of the designer and the personalised requirements of the consumer. Jewellery design and production is a craft learned through tacit knowledge and practice, traditionally through a system of passing down knowledge, gained through experience of generations (Orlandi & Erkan, 2015, p. 1).

The cyber revolution and the associated rapid advancement of technology have profoundly influenced the jewellery industry in both manufacturing and design processes. Digital production techniques including but not limited to three-dimensional printing have highlighted the conflict about the perceptions of value between the mechanically produced and the handmade jewellery piece (Fuchs, Schreier, & Osselaer, 2015, p. 98). The combined application of modern digital design technology with traditional methods of working by hand in the traditional studio jewellers' practice raises questions of authorship, authenticity, and craftsmanship. The problem is the synthesis of these opposing aspects and components in the post-cyber studio jewellery industry.

The studio jeweller primarily designs bespoke pieces of jewellery for consumers that attach a perceived higher value to handmade jewellery pieces. The conventional design process framework is based on the principle of design for manufacture. This principle considers manufacturing limitations and constraints of a product at the start of the design process (Cooper, 2015 p. 240) but with today's available technology designers can create virtually any geometry without the constraints of traditional manufacturing methods (Cooper, 2015, p. 240).

In Cape Town, studio jewellers have made some integration of digital technology, while others have shunned the integration completely. For this research, we analyse how the boundaries of the handmade have evolved in studios in Cape Town, South Africa. Does the jewellery community embrace the advances made in the tools available to the industry, or do they choose to remain within the traditional scope of the process? The researchers aim to explore the conditions for mechanical and digital design technology to be incorporated into the design and manufacture process of authentic jewellery.

## Literature

A literature review was initiated by a search for published academic articles, books and dissertations that investigate the challenges faced by studio jewellers. An initial online search was done using Google Scholar, Mendeley, Researchgate and Acedemia.edu using keywords "jewellery design", "digital craft", "jewellery processes", and "jewellery education". The search was then expanded using available online databases, including IEEE Xplore Digital Library, Bloomsbury Design Library, EBSCOhost, JStore, Scopus, Springer link and Klimt02: International Art and Jewellery online. The review revealed limited academic literature on jewellery processes in the current post-cyber age. The literature focuses on individual techniques rather than complete processes that include both the design and manufacture of the finished product. The list of titles that met the search criteria was inserted onto a spreadsheet to be evaluated for inclusion in the review. Based on their relevance to the post-cyber jewellery industry, 26 articles were selected for inclusion.

The table below illustrates how the articles selected for inclusion relate to the themes that emerged. These themes are then discussed in the following paragraphs.

EMERGED TOPICS	AUTHORS	TITLES	CONCEPTS
<b>History of processes</b>	Untracht, 2011	Jewellery concepts and technology.	The role of the studio jeweller within the larger industry.
	Orlandi & Erken, 2015	Value creation in jewellery fabrication today: Exploring the interrelations of crafts and innovation through the case of the grand bazaar of Istanbul.	Jewellery process learnt by means of tacit knowledge. Evolution of the industry within the space of the grand bazaar. Processes development.
	Gregoriotti, 1970	The history of jewellery design.	Traditional techniques as we know it today were established by the 15th Century. Progress and development of tools have enhanced the processes.
	Adamson, 2013	The invention of craft.	Craftsman not superseded by machine -Rather plays a vital role in its success.
	Harrison, 2010	Gold science and application	Development of tools enhances the quality and capability of making the field of jewellery design
	Prins, 2009	Gems and Jewellery. The South African Handbook.	The Industrial Revolution gave rise to modern tools and techniques which enabled the advancement of jewellery processes.
	Batista, 2017	A Contribution for Jewelry teaching.	Batista (2012) developed a framework to assist jewellery design students to work in a structured and methodical manner.
	Brepohl, 2001	The theory and practice of goldsmithing.	Young craftsman is in a position to evaluate the choice of tools and their position in the workplace. Advanced worker should be equally motivated to take advantage of the latest developments.
	Rajili, Olander & Warell, 2015	Characteristics of Jewellery Design : An Initial Review	Jewellery practice may also be characterised as positioned between craft and design-based approaches. What are the principles for jewellery design?
	Supsomboon, 2019	Simulation for jewelry production process improvement using line balancing: A case study	Simulation modeling is one of the powerful tools which could be used to analyze problems and study the behavior of production system. The research explores simulations to improve production in jewellery design.

<b>Blurred lines Handmade vs machine</b>	Corti, 2003	Technology is irrelevant to Jewellery Design — or is it ?	We think of jewellery design solely in terms of artistic design, and CAD systems used for jewellery design work from this artistic approach. The growing use of CAD illustrates that technology could facilitate artistic design and speed up the process.
	Fuchs, Schreier & Osselear, 2015	The handmade effect: What's love got to do with it?	No production process involves no machines, but the idea of handmade hold value with consumers.
	White, 2004	Hybrid Practice- Challenging Traditional Craft Boundaries: Authenticity: Anxiety: Autonomy.	CAD enables a new dialogue within practise. On the one hand there are more possibilities.
	Pettersson, 2019	Craft in the age of digital reproduction- a research into digital reproduction and its aesthetics.	Digital fabrication tools augment the hand of the maker.
	Bernabei, 2015	CAD/CAM and jewellery design education	CAD/CAM requires a similar knowledge base and practise of skill to accomplish.
	Manavis, Nazlidou, Spahiu & Kyratsis, 2020	Jewellery design and wearable applications: a design thinking approach	The potentials for reimagining the jewellery products in relation to the Design Thinking Process and CAD-based tools at the same time.
<b>Importance of handmade to the studio jeweller</b>	Fuchs, Schreier, & Osselear 2015	The handmade effect: What's love got to do with it?	Handmade-effect: Handcrafted is considered more valuable than industrially made.
	Lico, 2014	Applying 3D modelling technology to traditional craftwork: Rapid prototyping in artisanal Jewellery making and its impact on the perceived value of Jewellery.	Value increases sentimentally as the piece is worn on the body.
	Woolley & Niedderer, 2016	Real or unreal?-Crafting authenticity in the digital age.	Relevance of Authenticity in the digital age. CAD production raises questions in established understandings of making and of craft in terms of the hand-made and its individuality.
	Simptani & Barrett, 2020	Investigating the use of digital technology in Jewellery Design: A thematic analysis	Consumer perceptions must be steered toward creating the link between the concepts and aesthetics created by the jewellers.
	Sennett, 2008	The craftsman	Authenticity of the handmade process is evident in the uniqueness of the imperfection that the hand augments. The hand is the window on to the mind.
	Norton, 2014	Exploring the Negotiations over subculture Ideology of authenticity within the Etsy community.	Authenticity is understood as the inherent quality of an object and because it inherent it is not negotiable nor achievable.

<b>Designomics</b>	Hague, 2006	Unlocking the design potential of rapid manufacturing.	The use of rapid manufacturing could delink the relationship between complexity and cost.
	Hill, 2018	The jewellery industry's design dilemma.	If all the products in the market are essentially the same, then the only thing any customer will care about is price. Once customers only care about price, the market starts bleeding value.
	Hashim, 2018	Design economic evolution in the jewellery industry.	The value of a particular design is determined by the theories of economy in this influence.
	Cooper, 2015	Sintering and additive manufacturing: The new paradigm for the Jewellery Manufacturer.	Costs can be reduced with the inclusion of digital manufacturing processes
	Dauriz, Remy & Tochtermann, 2019	A multifaceted future: The jewelry industry in 2020	Fine jewelry has so far been immune to the effects of fast fashion, but not the fashion-jewelry market. Studio jewelers to enhance supply chain pace to stay competitive.
<b>Autonomy</b>	Cooper, 2015	Sintering and additive manufacturing: The new paradigm for the Jewellery Manufacturer.	Design for manufacture principle. Venture beyond boundaries of geometry of conventional jewellery making.
	White, 2004	Hybrid Practice- Challenging Traditional Craft Boundaries: Authenticity: Anxiety: Autonomy.	Investigates whether 2D image manipulation software, by 3D modelling hardware is informed by knowledge of production techniques in jewellery. CAD production has raised questions of authenticity and of control.
	Newman, 2015	An illustrated dictionary of jewellery	Jewellery design defined as a discipline where specialist knowledge and practice is applied to the conceptualising and making of jewellery products
	Hague, 2006	Unlocking the design potential of rapid manufacturing.	Expand the possibilities of geometry that is viable for production via the inclusion of rapid prototyping and digital production.
	Pettersson, 2019	Craft in the age of digital reproduction- a research into digital reproduction and its aesthetics.	The jewellery industry is a subtle balance between the originality of the author and the needs of the market.
	Scarpitti, 2019	Singular Multiples: Contemporary Jewellery Beyond The Digital	What the hand tells the Brain: Tool Use, Creativity and Embodied Cognition'. Jewellery making, constraints imposed by the materials used, the tools, the design brief, the aesthetic considerations or historical considerations.

Figure 1: Literature table (Authors, 2021)

### *The importance of the handmade for the studio jeweller*

The jewellery industry consists of various subsectors. Larger operations rely on mass-production processes to meet their supply chain demands, but the studio jeweller (small to medium-based

operations) mostly rely on traditional hand manufacturing processes to produce individual or collections of artisanal pieces (Pattersson, 2019, p. 3).

Despite the rise in popularity of high-quality machine-made products, the presence and popularity of handmade products have remained across most product categories. Jewellery design is also affected by the “hand-made effect” (Fuchs, Schreier, & Osselaer, 2015, p. 107) a phenomenon where handcrafted items are viewed as more valuable or desirable than mechanically made products. Handmade became a descriptor for unique jewellery items of a high quality (Orlandi & Erkan, 2015 p. 6; Lico, 2014, p. 32). The manufacturing of handmade jewellery is typically done individually that makes it improbable to create an object identical to another.

Uniqueness and rarity contribute to the appeal of handmade jewellery. This can be evident in small imperfections or slight differences in shape or form, from one piece to the next (Sennett, 2008:149). Lico (2014, pp. 32) also identifies the sentimental value of jewellery increases with time as it is worn on the body.

The term handmade is also often synonymous with authenticity. Norton (2014, p. 18) states that authenticity is understood as an inherent quality of an object and because it is inherent it is neither negotiable nor achievable. Authenticity in craft lies within the process and practice of the crafter. The process itself becomes authentic through the designer’s unique approach and combination of tools and techniques (Woolley & Niedderer, 2016, p. 160).

#### *The blurred lines between handmade and machine-made*

There are almost no production processes that do not involve machines or technology. A maker of handmade jewellery will use a machine to polish and finish a piece. Most mechanical production processes require some form of human involvement. The overlapping interactions of the hand and the machine make it difficult to objectively categorise a product as completely handmade or completely machine-made. This creates an opportunity to present a product as handmade and justify it as such (Fuchs, Schreier, & Osselaer, 2015, p. 107). The studio jeweller has always relied on traditional mechanical processes driven by expert craftsmanship and practice. Just like the hammer, digital fabrication tools augment the hand of the maker while simultaneously introducing specific tool-based limitations (Petterson, 2019, p. 5).

The production of work, using computer-aided design (CAD) has raised questions of authenticity and control. When using digital processes, the technology does not function autonomously, it requires the skill and knowledge of the operator (White, 2004, p. 3). The jeweller will apply their aesthetic to the design through the machine. The hand of the designer draws the control points of every line in a CAD programme that requires the same knowledge base and practice of skills to accomplish as any other traditional hand process (Bernabei, 2014, p. 18). Digital technology has therefore allowed the line between the hand and the machine to blur.

#### *Designomics*

Designomics is the collective term for design and economics (Hashim, 2018, p. 24). It describes the economic considerations of a design. The production of a tangible product happens through the design process where the combination of theme, concept, and ideation are incorporated. Connection and interaction between these conceptual values result in the final product. These values interact according to the parameters set by the client or the market for which the product was intended.

The design process before achieving satisfying jewellery will depend on a designer's understanding of need, science, technical knowledge, creativity, time frame, and costing (Hashim, 2018, p. 24). The cost of labour in conventional processes is directly linked to the intricacy and complexity of the design, these costs can be reduced with the inclusion of digital manufacturing processes (Cooper, 2015, p.

234). Jewellery products in certain markets have similarities. One example is the engagement ring market, where designomics plays a large role. A similar design can be produced with various methods both traditional and digital in various qualities, the principle of designomics is to determine the best method of producing a design at the market-related price-point with exceptional quality (Hill, 2018, p. 25).

### *Autonomy*

The application of digital design and manufacturing tools in the design process can allow the designer to create virtually any conceivable geometry without the restrictive capabilities of conventional manufacturing processes. Including digital design and manufacturing makes the complexity of a design and the cost of production independent from one another (Hague, 2006, p. 10).

Prevalent design methods and processes employed today are fundamentally based on the 'design for manufacture' principle. This principle considers the manufacturing of the product as a first step, whereas artistic value is usually the first step in the design process (Cooper, 2015, p. 236). By combining the ability of handmade techniques with innovative digital design technologies the studio jeweller could potentially access autonomous capabilities that will inspire design innovation and still hold the appeal of the handmade-effect the consumer prefers (Fuchs, Schreier, & Osselaer, 2015, p. 100).

### *The studio jeweller's design process*

Batista (2012) developed a framework to assist jewellery design students to work in a structured and methodical manner. Jewellery design can be described as an activity that involves the researching, creating, and planning of production. These activities focus on aesthetics, ergonomics, durability and designomics. The designer completes a complex arrangement of interrelated tasks before producing a finished piece, starting with the customer requirements, and ending with the specification of the manufacturing process. In South Africa, not all jewellery design graduates end up employed only as designers, some become designer-makers or studio jewellers. Technology is also evolving rapidly and therefore the jewellery design curriculum in South Africa needs to take these factors into account. Batista's (2012) framework included below is used as a starting point for this research on jewellery design and manufacturing processes for studio jewellers in a post-cyber context.

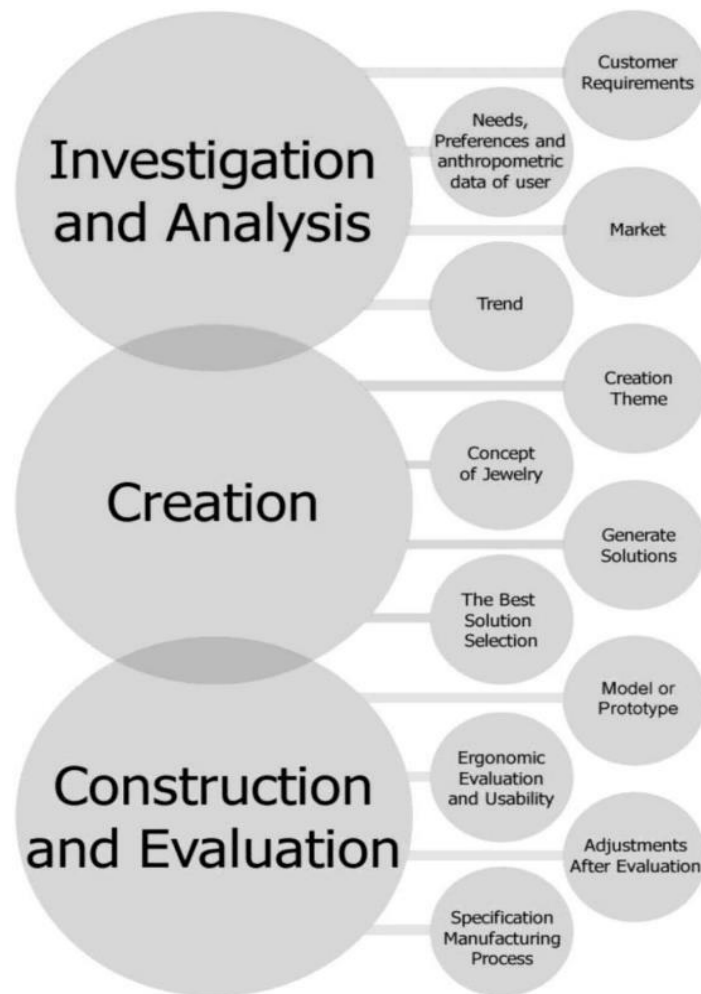


Figure 2: Jewellery design process (Batista, 2012)

The studio jeweller takes this process further to include production of the finished article. With experience, the designer-maker learns to predict results through empirical experimentation. No two designer-maker products are the same; there are constants in manufacturing determined by experiential knowledge and not strict formula. The combination of digital design technology processes with experiential knowledge when applied to new scenarios, allow the maker to venture beyond boundaries. White (2004 p. 11) characterises this as ‘technological opportunism’.

Authors indicate that the tools available to the studio jeweller should be assessed and evaluated according to the principles of historic value, handmade allure, designomics and autonomy (Hashim, 2018, p. 24; Fuchs, Schreier, & Osselaer, 2015, p. 100; Adamson, 2007, p. 21; White 2004 p. 10).

In the digital age, technology is developing exponentially, and in future, manual jewellery design and manufacturing processes could possibly be eliminated completely. In Cape Town, there are no studio jeweller’s processes that exclude manual labour in its entirety. In this research the authors explore a framework to guide processes that combine the handmade, mechanical and digital processes for the highest quality and intrinsic value.

## Method

The research design is based on the iterative reflective cycle by Coghlan (2019, p. 11). Every cycle consists of four stages that include Identify, plan, act and evaluate as illustrated in Figure 3 included.



In this paper we present the findings from the contextual enquiry, the first of three envisaged cycles of enquiry. The results presented here will inform the next cycle of research, which according to Coghlan (2019), consists of the co-design workshop.

The concept of reflective practice was introduced by Schön (1983) and provides an appropriate theoretical approach for research in jewellery design and practice. Schön states that professionals solve problems through tacit knowledge linked to activities, such as jewellery production and that they develop individual repertoires of solutions gained through experience. In this instance the jeweller learns to re-frame problems into manageable situations. Schön refers to the process as reflection, which can take place during and after a task for continuous professional improvement. The notion of lifelong learning is recognised as an important skill in fast-changing contexts.

Using Schön's theory of reflective practice as a lens, the authors aim to explore the incorporation of digital design technology into the studio jeweller's repertoire.

Reflective practice is the ability to reflect on one's actions to engage in a process of continuous learning. By asking jewellers to reflect on their practice, the authors attempt to answer the following research questions.

- To what degree are digital technologies incorporated in the practice of studio jeweller's; and
- And how could this inform the jewellery design curriculum?

The research seeks to analyse the process of design to articulate it as a translatable framework (Stewart, 2014, p. 4). The research is based on participatory action research that involves an action researcher and community or organisation who aim to solve a problem (MacDonald, 2012, p. 36). In this instance, the community is the jewellery practitioners. Participatory action research was selected because it allows the subject of the research to participate and collaborate with the researcher throughout the process (MacDonald, 2012, p. 38). Participatory action research is defined as the stage where most input is collected from stakeholders in an engaging manner with a focus on locally defined priorities and local perspectives (Cornwall & Jewkes, 1995, p. 1667).

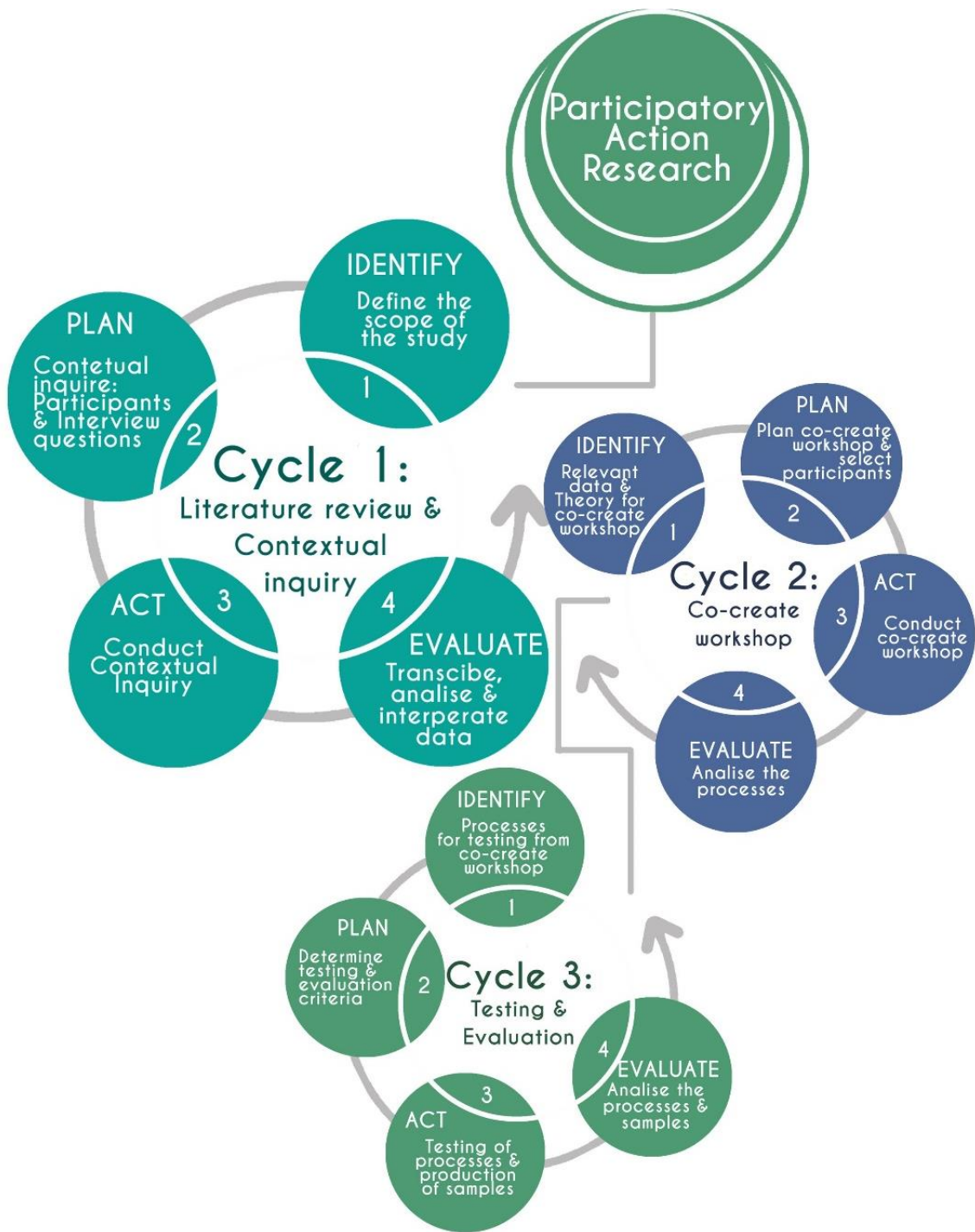


Figure 3: Research design and method (Authors, 2020)

## Participatory action research cycle one

### *Identify*

The first cycle aims to identify the processes that are currently used to create authentic handmade jewellery and establish to what degree they involve digital processes. The scope of the research was defined by conducting a literature review. Thereafter participants were identified to take part in the contextual inquiry into new possible technologies and processes that can be adopted by studio jewellers in the greater Cape Town area.

### *Plan*

Five jewellers in the Cape Town area were initially identified from a closed Facebook group of which one of the authors is a member and contacted via email to enquire whether they would be willing to take part in this research. A spreadsheet was drawn up to track who was contacted and respondents. From the first five initially contacted, the snowball technique was used (Parker, Scott & Geddes, 2019, p. 1) whereby those jewellers referred the researcher to further possible participants. In total, twenty-five jewellers were contacted, the restrictions imposed by COVID-19 made it difficult to engage with some participants and nine jewellers eventually participated. An informed consent form was discussed and signed by all participants on the understanding that their identity would be kept anonymous and that they could withdraw their consent at any time during the research.

### *Act*

Nine jewellers were interviewed during the contextual inquiry phase of the research, including three manufacturing jewellers, five studio jewellers and one technology based specialised manufacturer. Participants included high-end commission-based jewellers, specialist service providers to industry, art-jewellers who aim to bridge the gap between art and design and jewellers that serve a tourist market. Participants were purposefully targeted from different sections of the jewellery industry to obtain a broader range of perspectives to address the validity of the data. The interview guidelines were predetermined and conducted in a semi-structured manner (Hollway & Jefferson, 2011, p. 9). The conversational approach and the location of these interviews gave the researchers insight into the interviewee's perspectives and practices. The interviews were recorded and transcribed, before using Atlas-Ti to thematically code and analyse the data (Maguire & Delahunt, 2017).

## Discussion

### *Evaluate*

In this section we conclude the first cycle of the participatory action research by interpreting the data collected in the contextual inquiry. The data was coded thematically is presented under the following themes.

#### *The Importance of handmade in current practice*

The importance of the term handmade was discussed in the context of each jeweller's practice. It was interesting to note the extreme points of view. Interviewee 4 explain that her business is 'exclusively handmade'. From the design sketches to packaging production every step is done by hand.

Two jewellers interviewed have moved away from hand making completely as that title has had some associations to poorly made items. These jeweller's opinion were that the branding of how it was

made is not important. The service providers reiterated that the method is not important, but rather the quality of how it was made and the final aesthetic.

In contrast to these opinions four jewellers emphasise the importance of handmade to their practice. They describe the practice of making as a journey they embark on with every piece, as there is something spiritual about handmade jewellery as it engages with the human body.

Another jeweller mentioned that the allure lies in the exclusivity of the handmade and another opinion was that the handmade process provides the jeweller with control over every step, which adds an additional layer of authenticity. They reiterated that machines may be able to do things humans cannot, but the touch or the 'mark made by the human hand is where the magic lies' (Interviewee 5). That unique mark left on each piece is what makes handmade valuable and exclusive.

### *Application of digital tools in current practice*

The digital tools used by the scope of jewellers interviewed were similar, but the application of the tools and why they were selected, were varied throughout the design process in each practice.

Digital design software is used for illustration purposes by most jewellers interviewed. There is the application of complex three-dimensional computer aided design (CAD) software like Rhinoceros, as well as the application of simple software like quick-sketch on a tablet device and Photoshop to create a realistic effect. Jewellers who intend to produce the finished piece employing computer aided manufacturing (CAM) will apply three-dimensional software and render the design with plugin applications or Photoshop to present the design as a realistic illustration.

Digital design drawing tools have also been incorporated into the handmade process of push-engraving. It was interesting to note that the hand engraver would apply a digital method to transfer a design to the piece that needs to be engraved. They explain how they would transfer the design by means of light laser engraving, in this instance opposing technologies work in sync to create better economic value and increase the quality of the finished product.

Digital tools used in the making of sections of the process included microscopes for improved precision. The jewellers who applied CAD and CAM in their making process had different approaches to how these technologies should be applied in an authentic manner. Some jewellers outsource the CAD section of their process as they are not versed in the software, but still employ the technology. The CAM process is usually outsourced as it is rare for studio practice jewellers to own the required equipment. Other technologies noted in the making section of the process were the laser-based options such as micro-welding, laser welding, laser engraving and laser-cutting. These technologies are usually employed on an outsource basis to solve design-based problems.

### *Digital tools for the future*

The jewellers were asked if there were any tools that they would like to incorporate into their practice. These could be any tools or process that could aid the jeweller in their studio. Jewellers noted that even though there are many options for illustrating designs, that most of them are time consuming to apply to three-dimensional renderings. There is a need for design software for fast and realistic renderings to illustrate ideas to customers.

A large selection of the interviewed jewellers felt that there is technology available to them, they simply chose not to apply it in their practice, because they prefer to work by hand only.

Direct metal printing is a technology noted by some jewellers that needs to be explored. The technology already exists, but the application to the jewellery industry could be explored. Metal printing was noted as an option for the manufacturing of titanium rings, specifically as it is a difficult metal to work with by hand.

### *The current processes of studio jewellers*

Each participant was asked to describe their process from conceptualisation to production. This question was included to gain a better understanding of the workshop practice of the jewellers. It was interesting to note how personal this process is for most of the jewellers. It is described as a journey.

Jewellers follow a process of investigating, conceptualizing and making. These processes were mapped against Batista's (2012) model as illustrated in Figure 4. This basic process is adapted by the designers with their own unique steps taken and a variety of tools applied with each stage of their process. The first phase of the process is documented as organic according to the business structure of each studio jeweller. The suggested tool that could be incorporated in this phase is a web-based user interface with the client.

The creation phase of the process is where the idea will be conceived and presented to the client. Traditionally this would occur through hand sketches. Jewellers alluded that they have started to incorporate digital drawing software at this stage. There are multiple options available for lithographic drawing and full three-dimensional drawing. It was found that this is time consuming and there is still a need for a software that will allow for the rendering of three-dimensional sketches at a faster pace without a high level of skill.

Construction and evaluation have the most potential for the inclusion of digital technology. Models could be produced in wax as a realistic example or as a working model. Three-dimensional printing can be used as a starting point for a complex design, or a design can be printed in full detail ready to cast. These decisions will be determined by the economic implications and the complexity of the designs. The possibility to explore what other purposes this technology could be used for and where in the design process it could have the greatest positive effect.

Direct metal printing is a new technique that the jewellers interviewed viewed as something worth exploring to mitigate the difficulties of working in non-precious metals like titanium. These techniques could broaden the possibilities of design as the material and production could be more cost-effective. Laser welding and micro soldering is used for specialised intricate designs. These technologies broaden the boundaries within in which jewellers used to design.

The employment of outsource-based manufacturing was discussed. Digital tools are expensive, and it makes economic sense to outsource the application of these tools rather than carry the cost of running and maintaining these tools. It is considered common practice in the jewellery industry in Cape Town to outsource the casting of pieces to specialist companies. Outsourcing was also found to apply to CAD designs. The jewellers interviewed, those making use of technology and those that don't, do not have the skills for engaging with CAD software, and employ an independent contractor to complete these tasks.

### *Handmade jewellery with digital processes*

To determine what the parameters of the digital/handmade process could be, the jewellers were asked to what extent they think digital technology can be incorporated into the handmade process. It was interesting to note that the opinions were varied from no digital application in the process at all, to some jewellers saying that a mixture of processes will allow for the handmade title to stand in place. Authenticity of feel is also a comment made by some, meaning that if the piece attains the feeling of being handmade, irrespective of process, it is still considered to be handmade. Interviewee 3 noted that 'the piece should evoke a feeling for you, and if you connect to it, then you are connecting with the designer and maker'.

A selected group thought that CAD and CAM could be included in the handmade process, but with conditions. Interviewee 3 noted that 'whether it was designed completely on an interface, there is still a human involved'. CAD tools can be incorporated for presentation and manufacturing purposes. CAD

has multiple applications for the jeweller like illustration and creating files for the printing of 3D models for CAM. It is also applied for precise mapping of stone layouts or engraving details and to create symmetrical angles in traditional manufacturing. Parameters and limitations for the use of CAD for CAM in the handmade process noted by the jewellers during the contextual inquiry were the following:

- Design should be sculpted with the mouse and not use preset pieces;
- No preset stones in the wax;
- Pavé and micro setting should only be mapped and drilled; and
- Complex pieces should be drawn in separate pieces to ensure proper polishing and finishing in the final product.

Digital laser tools and processes like engraving, welding and cutting were still considered handmade. The jewellers stated that these processes involve the human hand throughout and can be considered handmade as it is a step in the creation of a piece and not the entire process. Digital tools that are aids to the manual process that were mentioned during the interviews were pneumatic engravers and microscopes, which assist with the manual process. “Nothing is simply handmade or machine made. Everything is a complex mix of different things and I think if we can embrace that complexity, we can really do some creative and exciting things” (Interviewee 5, 2020).

All parts of the process were noted and mapped between Batista’s (2012) framework for jewellery design students on the one hand and the appropriate digital tools on the other. By positioning the findings in between what currently informs the design curriculum and the digital processes available to industry practitioners, the authors aim to explore processes that can inform the studio jewellers practice and in turn the jewellery design curriculum to prepare graduates to enter the industry. The resulting conceptual framework is included in Figure 4.

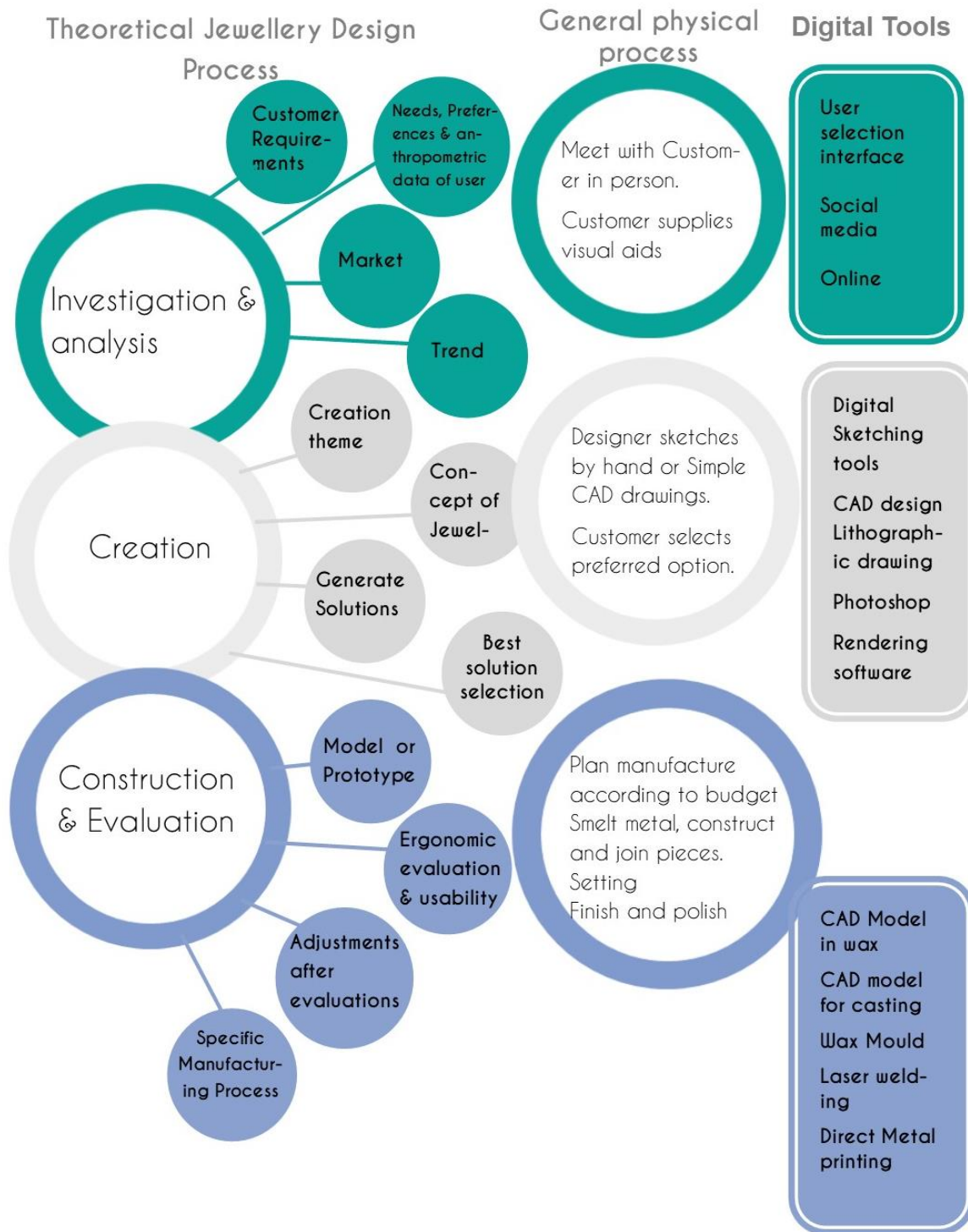


Figure 4: Towards a designomic framework for the post-cyber studio jeweller (Authors, 2021)

## Conclusion and recommendations

The contextual inquiry provided insight into what the current process of studio jewellers is, what the requirements or needs are and it informed possibilities of new processes and the inclusion of new technologies. The information gained from the contextual inquiry forms the basis of a proposed new framework which can be used for further research. The new process should aim to mitigate some of the problems or challenges that arose from the literature and the contextual inquiry.

No definitive consensus emerged but the participants all believed to some degree that digital tools require expertise and skill similar to the manual process. “Nothing is simply handmade or machine made. Everything is a complex mix of different things and I think if we can embrace that complexity, we can really do some creative and exciting things” (Interviewee, 2021). The opinion of another jeweller was that the tools applied are not what is important, but rather the maker's mark should be evident in the final product for the wearer.

A piece of jewellery could be considered handmade with the use of digital tools if the following considerations are included within the proposed new framework:

- The design should be authentic:
  - The mouse, not pre-set design algorithms, should be used to sculpt;
  - Digital design and manufacturing should be applied as scaffolding and not to create the finished product;
  - Setting should be done manually; and
  - Final finishing should be done by hand.
- Control over the process should remain in the hand of the designer:
  - Quality control inspection should be done.

The findings of this enquiry could assist the studio jeweller to remain relevant and competitive by employing a designomic approach, while retaining the authenticity of the “handmade” in a post-cyber society. The proposed framework will inform design education in the field of jewellery design in that digital processes can be included in the curriculum. Graduates need to be able to confidently toggle between methods and adapt to processes by embracing the efficacy of combining the handmade, mechanical, and digital processes for the highest quality and intrinsic value. There is also a need for flexible higher education programmes that can respond to the gap identified among studio jewellers for continued professional learning. Recommendations for further research include a co-design workshop to develop and test the proposed framework using participatory action research.

## References

- Adamson, G, 2007, *Thinking through craft*, 1st edn, Bloomsbury Publishing, London.
- Batista, CR 2017, ‘A contribution for jewelry design teaching’, *Design Journal*, vol. 20, sup1, pp. S4726-S4729, viewed 17 May 2021, doi: 10.1080/14606925.2017.1352973.
- Bernabei, R 2014, ‘Digital jewellery: The democratization of authorship and ownership’, *Craft Values in 21st Century Production, Conference Proceedings*, Falmouth University, 10-11 July 2014, *Conference Journal*, vol. 1, pp. 17-22, viewed 24 January 2020, [https://www.researchgate.net/publication/280877612\\_Digital\\_Jewellery\\_The\\_Democratisation\\_of\\_Authorship\\_and\\_Ownership](https://www.researchgate.net/publication/280877612_Digital_Jewellery_The_Democratisation_of_Authorship_and_Ownership).
- Coghlan, D 2019, *Doing action research in your organization*, 5th edn, Sage Publications, London.
- Cornwall, A & Jewkes, R 1995, ‘What is participatory research?’, *Social Science & Medicine*, vol. 41, no. 12, pp. 1667-1676, viewed 18 June 2020, [http://www.academia.edu/download/31450805/what\\_is\\_participatory\\_research\\_.pdf](http://www.academia.edu/download/31450805/what_is_participatory_research_.pdf).
- Cooper, F 2015, ‘Sintering and additive manufacturing: The new paradigm for the jewellery manufacturer’, *Johnson Matthey Technology Review*, vol. 59, no. 3, July 2015, pp. 233-242, viewed 10 October 2019, <https://www.technology.matthey.com/article/59/3/233-242/>.
- Fuchs, C, Schreier, M, & Van Osselaer SMJ 2015, ‘The handmade effect: What’s love got to do with it?’, *Journal of Marketing* vol. 79, March, pp. 98–110, viewed 16 August 2019, doi: 10.1509/jm.14.0018.



- Hague, R 2006 'Unlocking the design potential of rapid manufacturing', in *Rapid manufacturing: An industrial revolution for the digital age*, pp. 5-18, John Wiley & Sons Publishing, Loughborough University, United Kingdom.
- Hashim, HZ 2018, 'Design economic evolution in the jewellery industry', *Journal of Applied and Fundamental Sciences*, vol. 10, special issue 4 2018, viewed 4 September 2019, [https://www.researchgate.net/publication/325313374\\_design\\_economic\\_evolution\\_in\\_the\\_jewellery\\_industry\\_through\\_design\\_process](https://www.researchgate.net/publication/325313374_design_economic_evolution_in_the_jewellery_industry_through_design_process).
- Hill, A 2018, 'The jewellery industry's design dilemma', *Forbes*, viewed 4 September 2019, <https://www.forbes.com/sites/andreaahill/2018/08/17/the-jewelry-industrys-designdilemma/#5fd84a7c65ea>.
- Hollway, W, Jefferson, T 2011, 'Producing data with defended subjects', in *Doing qualitative research differently*, pp. 27-54, Sage Publications, London, viewed 15 June 2020, doi: 10.4135/9781849209007.
- Jewellery Council of South Africa 2019, *JCSA Annual Report*, viewed 15 June 2020, <https://www.jewellery.org.za/jcsa-annual-report-2019/>.
- Lico, C 2014, *Applying 3D modelling technology to traditional craftwork: Rapid prototyping in artisanal jewellery making and its impact on the perceived value of jewellery*, University of Montreal, viewed 16 August 2019, <https://papyrus.bib.umontreal.ca/xmlui/handle/1866/12725?show=full>.
- Maguire, M & Delahunt, B 2017, 'Doing a thematic analysis: A practical, step-by-step guide for learning and teaching scholars', *All Ireland Journal of Higher Education*, vol. 9, no. 3, viewed 18 February 2020, <https://ojs.aishe.org/index.php/aishe-j/article/view/335>.
- MacDonald, C 2012, 'Understanding participatory action research: A qualitative research methodology option', *Canadian Journal of Action Research*, vol. 13, no. 2, pp. 34-50, viewed 19 June 2019, <https://journals.nipissingu.ca/index.php/cjar/article/view/37>.
- Newman, H 2015, *An illustrated dictionary of jewellery*, 2nd edn, Thames & Hudson, London.
- Norton, E 2014, *Exploring the Negotiations over the subcultural ideology of authenticity within the Etsy Community*, University Utrecht, viewed 4 September 2019, <https://dspace.library.uu.nl/handle/1874/295480>.
- Orlandi, AC & Erkan, Y.K 2015, 'Value creation in jewellery fabrication today: Exploring the interrelations of crafts and innovation through the case of the grand bazaar of Istanbul', *11th European Academy of design Conference*, viewed 18 June 2020, [http://www.academia.edu/download/53148120/EAD-11-CoskunOrlandi\\_fullpaper.pdf](http://www.academia.edu/download/53148120/EAD-11-CoskunOrlandi_fullpaper.pdf).
- Parker, C, Scott, S & Geddes, A 2019, 'Snowball sampling', P Atkinson, S Delamont, A Cernat, JW Sakshaug, and RA Williams (eds), in *Sage research methods foundations*, viewed 5 July 2020 doi: 10.4135/9781526421036831710.
- Pettersson, A 2019, 'Craft in the age of digital reproduction – a research into digital reproduction and its aesthetics', *Journal of Jewellery Research*, February, pp. 1–17, viewed 16 August 2019 <http://www.journalofjewelleryresearch.org/download/annika-pettersson/>.
- Sennet, R 2008, *The craftsman*, 1st edn, Penguin Group, London, pp. 326.
- Schön, D 1983, *The reflective practitioner: How professionals think in action*, Maraca Temple Smith, London.
- Stewart, S 2014, 'Design research', in *The Sage encyclopedia of action research*, pp. 246-247, Sage Publications, London, viewed 25 October 2019, doi: 10.4135/9781446294406.

White, H 2004, 'Authenticity, anxiety, autonomy', *Challenging craft*, pp. 1-12, viewed 16 August 2019  
doi: 10.1.1.118.9247.

Woolley, M & Niedderer, K 2016, 'Real or unreal? Crafting authenticity in the digital age', *Craft Research*, vol. 7, no. 2, pp. 159-164, viewed 4 September 2019, <https://e-space.mmu.ac.uk/622130/3/CRRE%207.2%20Editorial%20v04%20%281%29.pdf>.