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Exploring manual and digital pattern design methodologies towards the development of the design education offering

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Abstract

This paper considers the importance of preserving 'hand-skills' in fashion design education for students to acquire the ability to visualise the shape, proportion and fit of a garment instead of relying solely on a computer. In addition, the apparel industry requirement for patternmakers to be familiar with digital patternmaking technology to speed up the efficiency of the patternmaking component of the manufacturing process is of equal importance. Both techniques are examined and compared in the research.

The connection between manual patternmaking and computerised technology when constructing patterns for the fashion industry is explored through means of qualitative research and purposive sampling for this paper.

The theoretical framework that underpins the study is the System Theory, which also guided the methodology used in this study. The Inputs, as part of the system theory, include both computer-generated patternmaking and manual patternmaking systems to produce outputs in the form of garments. The transformation of a garment, during construction, is part of a system and usually requires an expert machinist. The output of a system for garment construction usually includes a mock garment that guides the evaluation of fit. The creativity and functionality in the physical fit, aesthetic fit and functional fit of both the digital and manual results are assessed.

The findings from this study reveal the important role of manual patternmaking, in combination with the digital capabilities that the industry requires from pattern designers. It is evident from the findings that alternative education approaches in fashion design courses should be considered. Such an alternative approach may involve consideration around, training time and the potential for inter or multi approaches by including both: manual and digital patternmaking techniques. Computerised pattern design approaches are an indispensable instrument to keep pace with the advances in the garment industry, but this research proves that it is necessary for the future generation, in a world of technology, to learn manual patternmaking skills in order to preserve a high standard of technical knowledge.

Applying both manual and digital patternmaking approaches to pattern design courses advance the continuation of manual skills, yet, includes a collective learning setting where students are involved in the progression of a career-orientated learning experience, preparing them for the technological world that they are about to enter.

Keywords: aesthetic fit, digital patternmaking, functional fit, manual patternmaking, pattern-design, physical fit

Introduction

Mechanised textile manufacturing launched the textile and clothing industry into the first wave of mass production and led the way into the first industrial revolution (Boydell, 2010). As the South African fashion industry negotiates the fourth industrial revolution, it is evident that South Africa is underprepared (Campbell, 2017). However, digitally rendered patterns are already well established in the fashion manufacturing process and significantly accelerate output rate (Datta & Seal, 2018). Equally important, is manual patternmaking in the development of fundamental pattern design skills (Schenk, 2007). This paper considers the comparative outcome of digitally rendered patterns to manually crafted patterns taking into consideration the complexity of the design, grade-ability of the pattern, timekeeping, the quality and accuracy of the finished patterns, the truthfulness to the original design and a comparison of the fit in the sample garment.

The value in comparing pattern design methodologies is to inform possible future study directions in patternmaking. The benefits of a multi-method approach are well worth exploring to give learners an all-inclusive outcome in the area. Strong design is initiated through a sound knowledge of pattern cutting in combination with a good understanding of body measurements, shape, proportion, and silhouette. A combination of technical and creative skills merged with theoretical approaches is applied during the pattern design process. The competence to visualise and realise an end product necessitates the development of the before mentioned skills. For an experienced practitioner, this comprehension is fundamentally learnt through repetition and observation (Pritchard, 2013). For a student, practising patternmaking principles, the comprehension and competence to visualise and realise a successful end product is yet to be achieved as they are in the learning phase of repetition and observation. The objective for tertiary institutes is to prepare the student for industry (Schenk, 2007). Undoubtedly the fourth industrial revolution asks for more than traditional educating approaches (Selingo, 2018).

It is also important to understand the preservation of 'hand-skills' in fashion design education and the influence of manual patternmaking on a student's ability to visualise the shape, proportion, and fit of a garment instead of relying solely on a computer (Pritchard, 2013). In addition, the apparel industry requirement for patternmakers to be familiar with digital patternmaking technology to speed up the efficiency of the patternmaking component of the manufacturing process is of equal importance. Published research on the comparisons between manual patternmaking (Joseph-Armstrong, 2006 & Nakamichi, 2010 & Nakamichi, 2011) and digitally rendered patterns (Stott, 2012) is rare, but regardless of the infrequency in documentation, the advantages of the investigation lie in the considerations and bearing of computerisation on pattern creation as this is significant for the prospects of manufacturing standards.

In particular, Dr Pam Schenk (2007), a key writer in the field of 'hand-skills' in design, extensively researched paper-based design, and through her findings provides various reasons for the significance drawing plays in concept development. She explains that: "the consistent and overwhelming finding of [her] work is that drawing remains at the very centre of the creative and developmental process of design". Suitable techniques and regular drawing preserve 'visual literacy', the capacity to improve ideas, and observational skills. Drawing also generates an awareness of an essential perception and comprehension of scale and organisation (Schenk, 2007). For this reason, conventional manually crafted patterns could play a significant role in design development. Manual patternmaking allows for the realisation and development of new design ideas on paper while simultaneously refining the means of visualising a design when three-dimensional shapes are created on a figure form by means of pinning pattern pieces together on the form. A specialist patternmaker's methods will

regularly include knowledge that is not easily verbalised but fundamentally acquired through experience and observation (Brown & Duguid, 1998).

Fasanella on the other hand, works as a manual patternmaker and a digital patternmaker, her opinion is that: “People are losing sight of the difference between preferences, available tools, and skills” (Fasanella, 2012). She explains that both methods have their advantages and can be equally efficient. Fasanella (2012) also states that pattern making is a time-consuming process and can proportionately exhaust time whether being done digitally or physically. Computer-aided design (CAD) does however reduce the time needed on slight pattern alterations and styling modifications. CAD also “facilitates the ease of offshoring product development” (Fasanella, 2012). However, digital patternmaking could also possibly be a disadvantage for clothing manufacturing regarding the maintenance and experience of industry knowledge. She concludes by saying that: the knowledge and skill in patternmaking supersede methodology (Fasanella, 2012).

Literature survey

Dr Pam Schenk (2007) says: “Drawing is about thinking, analysing, exploring and imagining”. Manual pattern construction requires reasoning, technical drawing analysis and the exploration of shape, proportion and silhouette in the process to enable successful outcomes (Schenk, 2007). A parallel could be drawn between drawing and manual patternmaking in the deliberation and interpretation of information, also the re-interpretation and re-production of the initial design to create a three-dimensional solution (Sennet, 2009). Therefore, it could be debated that digital pattern making prevents self-directed innovation and comprehension of pattern outcomes and the purpose in pattern manipulation actions that are required to construct a particular result (Sennet, 2009). Schenk (2007) concludes by saying that: “It is also important for students to realise that much design software has actually been developed through research into the practice of design. Without the experience of the ‘physical’ world of paper-based drawing, students will struggle to understand many of the tasks that the digital media have been developed to perform”. Flat patternmaking principles, namely dart manipulation, added fullness and contouring as explained by Joseph-Armstrong (2006) are essential to the success of the garment outcome and fit. This is also why the preservation and teaching of hand skills in patternmaking is essential in a technological world amidst the apprehension of the fourth industrial revolution.

Pattern design books are “based on the contributions of great patternmakers of the past and adds to them new innovations and concepts gained through years of experience in the industry and in the classroom. … Comprehensive enough to be a valuable tool now and in the future regardless of fashion trends” (Joseph-Armstrong, 2006).

Although there is an infrequency on the comparisons between manual patternmaking (Joseph-Armstrong, 2006; Nakamichi, 2010; Nakamichi, 2011) and digitally rendered patterns (Stott, 2012), Hodakel (2020) states that “technology [makes] it easier to produce accurate designs that speed up the production process”. Hodakel (2020), explains how computer-aided design can synchronise numerous manufacturing procedures in the clothing industry, especially for patternmaking and grading. Illustrations are digitised, which are then printed by garment plotters. “The use of innovative software enables businesses to keep up with trends and garment development through intelligent platforms” (Hodakel, 2020). Fast fashion is partially realised through digital pattern creation, an irreplaceable tool for improving efficiency and productivity. Software solutions include Lectra, Gerber Accumark, Optitex, Autodesk and Assist (Hodakel, 2020).

Fasanella (2012) works with both patternmaking methods and is of the opinion that they are mutually efficient and that each method has its advantages, but includes that the time spent on pattern alterations is less when using CAD. The interesting point that Fasanella makes is that the drawback in digital patternmaking could remain in the maintenance and proficiency of industry knowledge. This is a similar thought that Helen-Armstrong makes when she talks about the "years of experience in industry" Fasanella (2012) presumes that the comprehension and skill in patternmaking supersede methodology (Fasanella, 2012). Most present patternmakers however, have initially been trained as manual patternmakers making it difficult to determine the result of the developmental process when paper-based-patternmaking is excluded.

To resolve this dilemma, this paper addresses the question: What is the outcome when comparing digitally rendered patterns to manually crafted patterns while including the assessment of the garment, complexity of the design, grade-ability of the pattern, timekeeping, the quality and accuracy of the finished patterns, the truthfulness to the original design and a comparison of the fit in the garment? Shin (2016) evaluates the complex concept of garment fit through the lens of three measures: Physical fit, Aesthetic fit and Functional fit.

Physical fit is described as "features of fit that are physically perceived in terms of the relationship between clothing and body, such as tightness and length" (Shin, 2013: 44). In earlier studies, Shin found that customer inclinations contrast in opinion when considering the tightness of clothing fit. Supplementary to the tightness of fit, the length of garments also needs consideration as taller people favour clothing that is long enough for their limbs, while shorter customers select pieces where the length of the garment is appropriate for their body height. In consequence, customers evaluate a good physical fit by the extent to which they have had difficulty in past experiences concerning appropriate physical fit for their figure and height (Shin, 2016).

Aesthetic fit is explained as "features of fit that are visually perceived and assessed when looking at an individual's dressed body, such as overall appearance related to the body and attractiveness" (Shin, 2013, p. 44). Consumers assessed aesthetic features of fit based on how the clothing looked when wearing the piece, whether the garment displayed positive features and concealed imperfections. Shin stated that examining only physical fit limits the consumers' insight of fit because the customers' observations include other elements, such as personal style, current fashion trends, and personal impressions of their own figure (Shin, 2016).

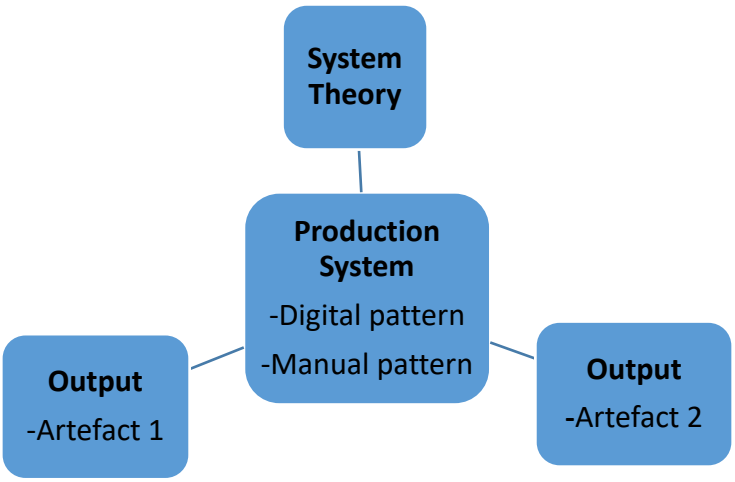
Functional fit signifies "features of fit that are perceived when the dressed body is moving for activities, related to restriction or lack of restriction of movement" (Shin, 2013, p. 44). A garment that fits well allows the wearer to move comfortably while performing activities and also to move easily in the clothing itself. "Depending on the activities in question and personal preferences, different levels of functional fit may be preferred at different times" (Shin, 2016).

In the data collection phase of this study, the researcher relied on these fit measures and qualitative findings to assist in the assessment of the pattern and garment outcomes.

Research method

Clothing production and planning can be represented through 'System Theories' and patternmaking as a part of the production system that connects patternmaking and manufacturing technology (von Bertalanffy, 1969). The research method, therefore, includes manual and digital patternmaking processes and the sample construction of both patterns by

an expert tailor. The transformation process results in the output of pattern and garment comparisons.



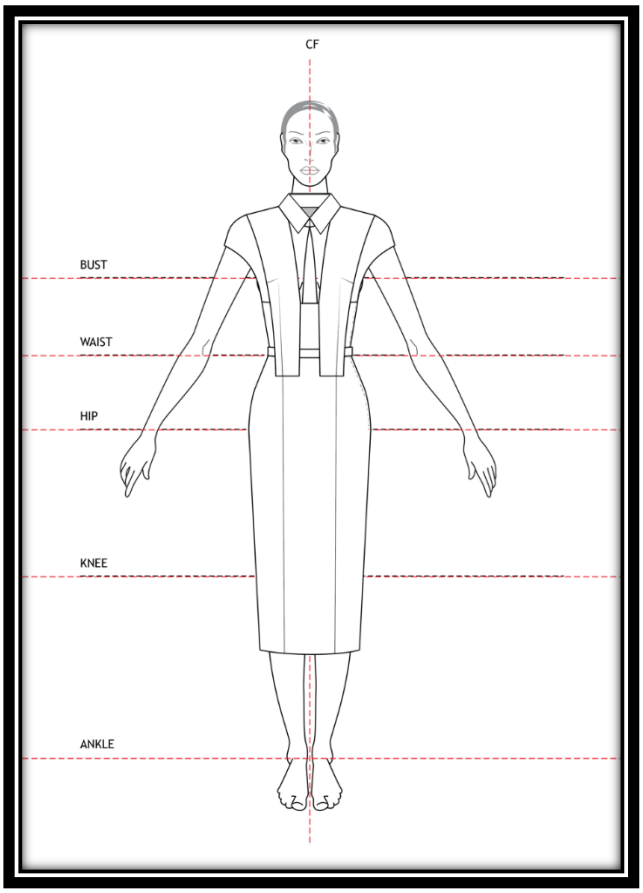
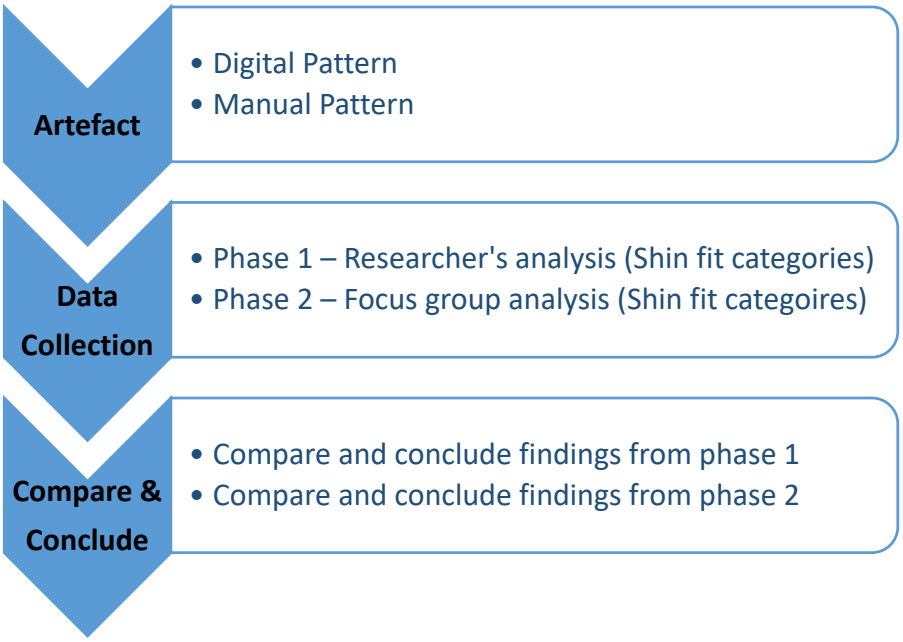


Figure 1: Front view, technical drawing

The technical drawings supplied to the pattern makers were based on current trends and the patternmaking principles as per the recordings and investigations of Joseph-Armstrong (2006). These visuals include the silhouette, proportion, and fit of the design. A pencil skirt design is based on a garment that closely echoes the basic hip silhouette. This design permits measuring the 'fit' of the skirt part with the slightest inconsistencies. Comparisons between the patterns and samples to inform the research were outlined in assessment templates evaluating the silhouette, proportions and fit of the sample dresses.

Purposive sampling in terms of selecting patternmakers for this project was crucial as the skillset of the patternmaker is not compared, but the different methods in patternmaking. The patternmakers were chosen based on their competency and experience in their field of expertise. These two patternmakers drafted the manual and digital patterns respectively for the same dress design. Sample construction garments of both patterns were made.



Qualitative data collection emerged in content consideration and artefact evaluation comparing the difference in manual and digital pattern fit. Visual analysis of the artefact samples was performed to interpret participants perception of fit based on the measures as described by Shin. The overall assessment of samples was concluded through the opinions of an focus group. The focus group made up of five industry experts, an international model, a fashion photographer, a make-up artist, a designer and design assistant, gave their opinion during an interview on the fit of the sample dresses. To gain deeper insight on the subject of fit, the researcher posted photos of the two samples on Instagram and asked individuals to comment on the fit. The methodology concluded and informed critical comparisons of digital and handmade patternmaking methods to support the study.

Data collection criteria were simplified through an operational table that redeems all the objective issues in the study based on the fit measured as explained by Shin.

Table 1: Scheepers. 2020. Operationalisation table of the objectives. South-Africa

Objectives	Measurement tool	Justification
Compare and analyse the Physical fit against the garment proportions of both the mock-up samples respectively.	The fit in garment features that are physically perceived such as length and tightness will be measured under the heading of Physical fit (Shin, 2016).	Records of the actual measurement differences that influence the Physical fit in a garment
Compare and analyse the Aesthetic fit against the garment silhouette of both the mock-up samples respectively.	Aesthetic fit will measure the attractiveness of how the garment clothes the figure (Shin, 2013: 44).	To compare and analyse the Aesthetic fit against the garment silhouette of both the mock-up as recorded by Shin (2016)
Compare and analyse the Functional fit, of both the mock-up samples respectively.	Functional fit signifies and is synonym with the comfort of movement in a garment (Shin, 2013: 44). "Thus, for a garment to meet the needs and desires of the consumer, body measurements, comfort and ease preferences must be translated into [pattern] measurements" (LaBat, 1987: cited in Pritchard, 2013).	Comprehensive appraisals on the creativity and the functionality deemed suitable for the fit of the garments presented.

Artefact evidence

Sample dress – **Manuel pattern** photographic evidence (close-up)

Figure 2: Front view, mock-up sample, close-up photo of the manually crafted pattern. South Africa (Photographer: Burger, 2020. Photographed by Burger, South Africa, 2020.)

Sample dress – **Digital pattern** photographic evidence (close-up)

Figure 3: Front view, mock-up sample, close-up photo, of the digitally rendered pattern. South Africa (Photographer: Burger, 2020. Photographed by Burger, South Africa, 2020.)

Sample dress – **Manuel pattern** photographic evidence (front)

Figure 4: Front view, mock-up sample, full-length photo, of the manually crafted pattern. South Africa (Photographer: Burger, 2020. Photographed by Burger, South Africa, 2020.)

Sample dress – **Digital pattern** photographic evidence (front)

Figure 5: Front view, mock-up sample, full-length photo, of the digitally rendered pattern. South Africa (Photographer: Burger, 2020. Photographed by Burger, South Africa, 2020.)

Sample dress – **Manuel pattern** photographic evidence (back)

Figure 6: Back view, mock-up sample, full-length photo, of the manually crafted pattern. South Africa (Photographer: Burger, 2020. Photographed by Burger, South Africa, 2020.)

Sample dress – **Digital pattern** photographic evidence (back)

Figure 7: Back view, mock-up sample, full-length photo, of the digitally rendered pattern. South Africa. (Photographer: Burger, 2020. Photographed by Burger, South Africa, 2020.)

Discussion of results

The images below highlight proportional differences between the original technical drawing and the made-up samples of the digital and manual patterns. Horizontal balance lines in red mark the similarities and differences between the technical drawing and the different samples. The greater majority of the proportions in both outcomes are creatively and functionally suitable within the proposed sample with a skilled approach evident that underpins proportional awareness.

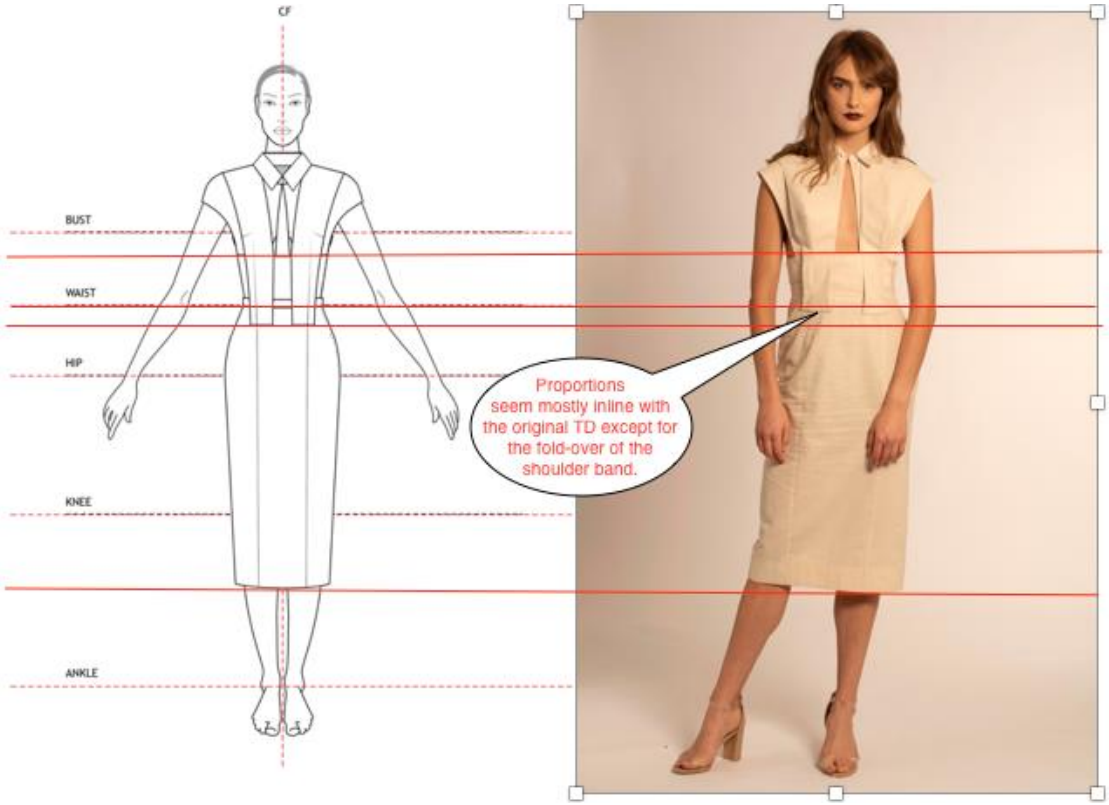


Figure 8: Front, technical drawing and manual pattern mock-up sample comparison. South Africa (Scheepers, 2020)

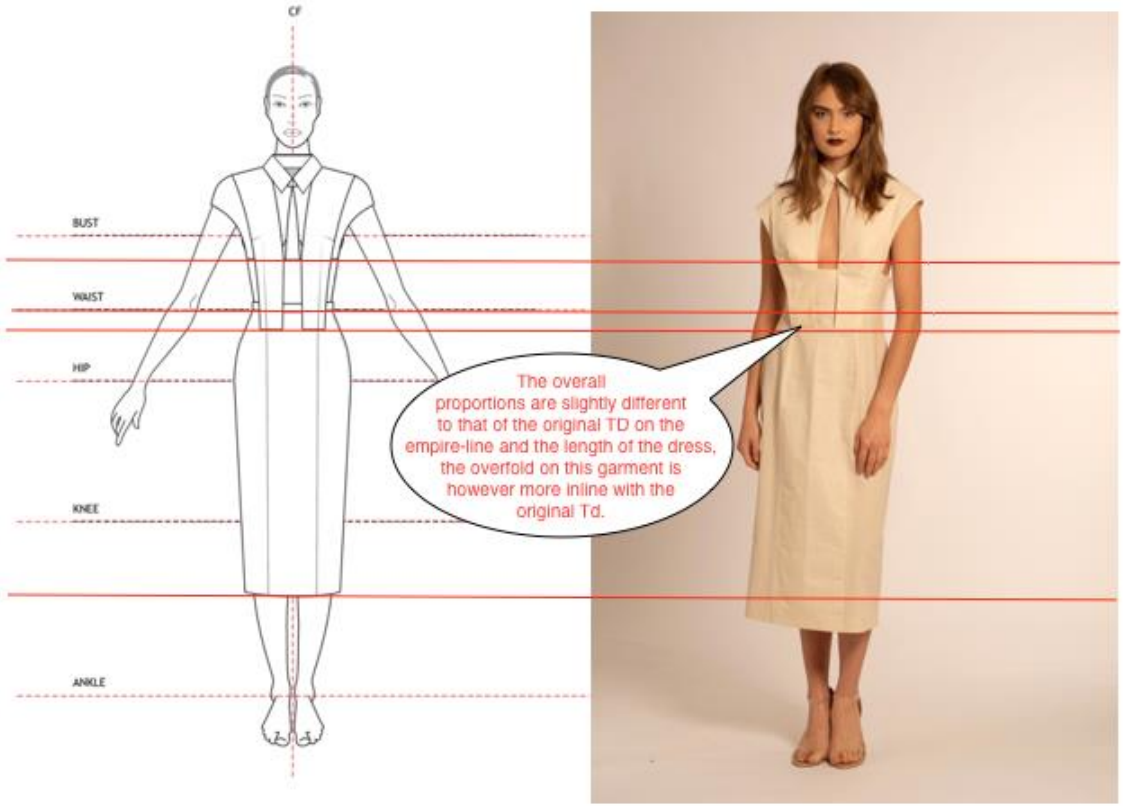


Figure 9: Front, technical drawing and digital pattern mock-up sample comparison. South Africa (Scheepers, 2020)

Proportionately the front panel fold-over at the waist of the sample, made from the manual pattern, is not relevant according to the specifications of the supplied design. The fold-over done by the digital patternmaker is more suitable in this perspective.

The proportions, including the hem length, empire line and the back-panel seam of the sample made from the digital pattern are, however not relevant according to the specifications of the supplied design. An appraisal of the back view can be seen in Figure 10 and Figure 11. The major differences between the technical drawing and both the pattern outcomes are that the technical drawing requires seven pleats in the centre back inset. The manual pattern maker included six pleats. The balance line for the seventh pleat is indicated but not actually manipulated into a pleat. The digital patternmaker included eight pleats in the inset, where four pleats are created on the first side from the centre back and mirrored onto the opposite side.

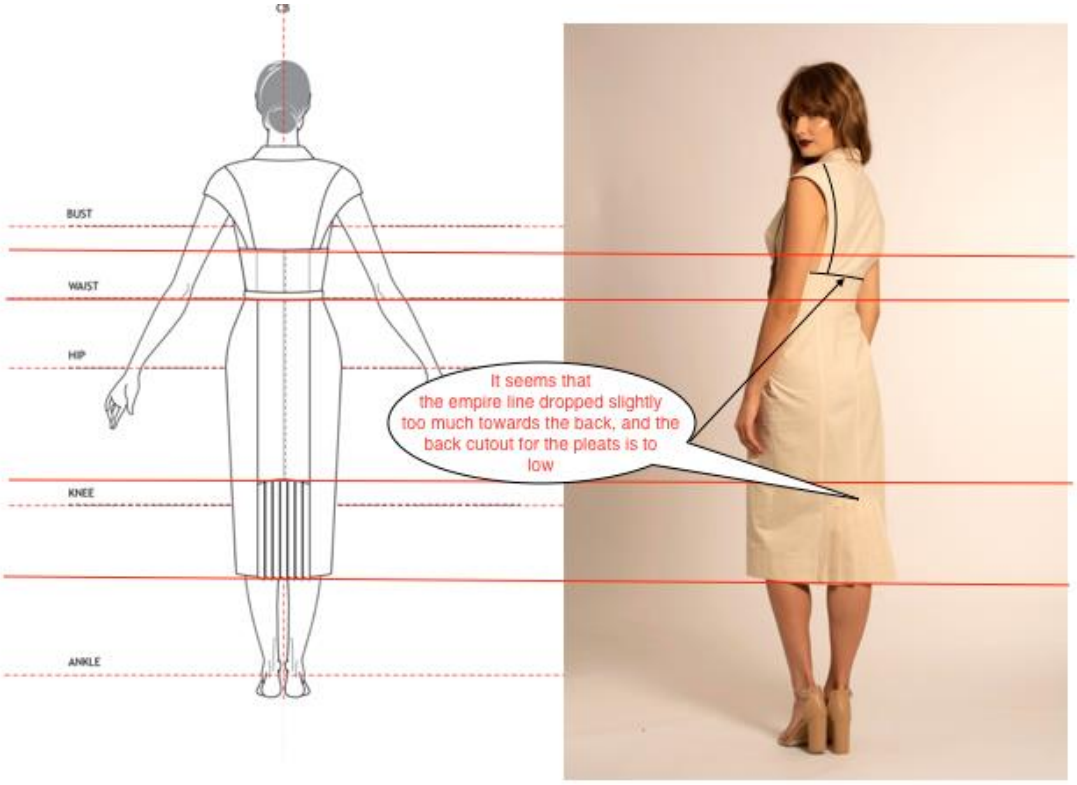


Figure 10: Back, technical drawing and manual pattern mock-up sample comparison. South Africa (Scheepers, 2020)

Through the research, it became clear that Shin (2016) made well-defined observations on customer inclinations and their contrasting opinions when contemplating the tension and looseness of the fit in clothing items. Supplementary to the tightness of how the garment fits, the proportions and length of the skirt were also considered by the focus group. In consequence, it could also be assumed that individuals evaluated the physical fit of the dress by the extent to which they have had difficulty in past experiences concerning appropriate physical fit for their own height and figure (Shin, 2016).

The focus group of industry experts mostly voted in favour of the manual pattern sample dress. The overwhelming comment on the dress made from the manual pattern was that the dress seemed tailor-made. Comments from the panel on the dress made from the digital pattern were that the dress seemed too long and also seemed too big for the model as the skirt did not echo the hip shape snuggly. The public vote on Instagram, with a small percentage of 20% also indicates that they favour the fit of the mock-up made from the manual pattern. This marginal difference in judgement on the physical fit of the garment stresses the research of Shin (2016).

The focus group assessed the aesthetic fit features of the mock-up made from the digitised pattern as mass-produced and flat. Once more, the individual observations from the Instagram vote include other elements and an equally divided opinion was shared. Some appreciated the looser fit and proportions, and also appreciated the commercial value that the garment (made from the digitally rendered pattern) displayed. Functional fit relates to the ease of movement when wearing a garment" (Shin, 2013: 44). Both dresses fit well and allow the wearer to move comfortably in the garment. The professional model did, however, prefer the fit of the mock-up made from the digital pattern on the torso area.

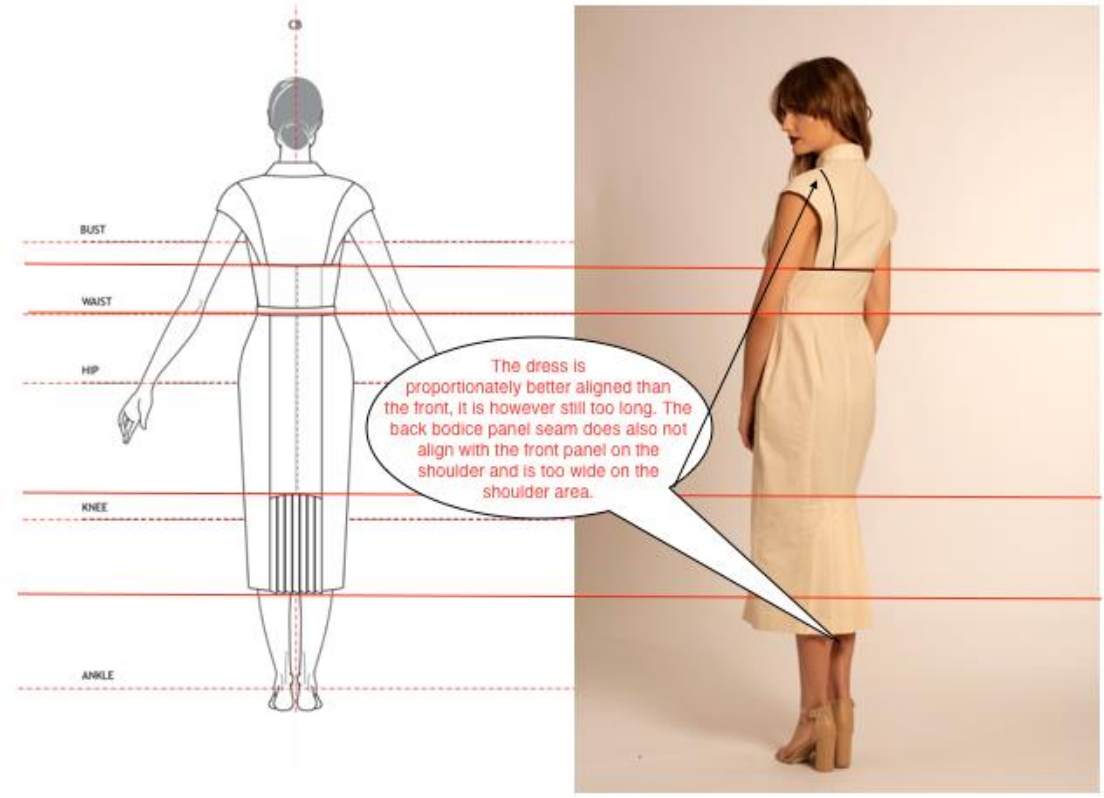


Figure 11: Back, technical drawing and digital pattern mock-up sample comparison, South Africa (Scheepers, 2020)

The difference in the interpretation of the silhouette and proportion was highlighted by gathering data and comparing the dissimilarities in garment measurements. In this case, most of the measurements, when comparing the two methods closely align. Obvious differences in proportion interpretation were in the variation of the measurement on the collar, the length of the skirt and the number of pleats in the CB inset. These differences highlight the deliberation regarding the importance of the patternmaker having the proficiency to visualise the three-dimensional outcome from the illustrated two-dimensional drawing. As both the pattern makers were highly skilled professionals, and the outcome on both garments were successful, the differences do not necessarily point out the inability to visualise, but rather strengthen the position of the two patternmakers in their fields.

The significance of traditional patternmaking skills being maintained remains in the undertaking of the process. Self-directed creativity and comprehension are developed through technical drawing analysis while assessing the shape, proportion and silhouette when manipulating patterns (Schenk, 2007). Although three-dimensional views of a design can be obtained through digital technology, the digitisation process does not necessitate a similar exploration in the silhouette, proportion and fit of the item.

During general public evaluations of the pattern outcomes, it was clear that the innovation and functionality in the 'Physical fit', 'Aesthetic fit' and 'Functional fit' (Shin, 2013: 44), of both results, were equally accepted on a commercial platform. Personal views from the audience did nonetheless indicate the need for customisation in a tailor-made piece when sharing their sentiments on the fit sequels.

The skill application of both participants proved understanding far beyond fundamental patternmaking. It was nevertheless remarkable that the outcome of the digitised pattern proved to have a higher commercial value in terms of a ready-to-wear appeal as viewed by a

marginal percentage of participants. The argument to this statement does remain that readymade garments do not fit every individual figure perfectly. A great advantage of digital technology is that the digitised pattern is much quicker and easier to grade into different sizes and that the speed of pattern alterations and delivery globally, is much faster. The quality and accuracy of the finished patterns in both cases were excellent and seem to be reliant on the skill and punctuality of the patternmaker and not so much the chosen method. The findings and data analysis does suggest the preservation of 'hand-skills' in order to preserve patternmaking perceptive, but vividly prove the prerequisites of new technologies in a global fast-fashion market. The need for both old and new methods of patternmaking is not displaced and remain possible study directions for young designers.

Conclusions

Current product offerings of fashion institutes incorporate learning to establish an in-depth comprehension of manual pattern making. With the loom of a fourth industrial revolution, it seems essential that higher education adjust classic teaching modules. Within the current digital era, deliberation on whether a far-reaching grasp in the craft of manual pattern making will be required in the future, is mandatory. The question remains whether the art of manual patternmaking will be preserved if digitised programmes assist the patternmaking process.

The Literature review includes relevant research that assisted in the exploration of patternmaking methods. Dr Pam Schenk (2007) stresses the importance of maintaining 'hand-skills' in fashion design education in order for students to acquire the ability to visualise the shape, proportion and fit of a garment. Fasanella (2012) recognises the advantages of each patternmaking method, but includes that the downside of digital patternmaking could remain in the preservation and proficiency of industry knowledge.

Qualitative data collection for this study transpired through content analysis and artefact evaluation. These findings do, however, inform the adaptation of both manual and digitised pattern design modules on a tertiary level to enable a more wholesome multi-method approach in preparing fashion design students for the industry. Collectively, incorporating both digital and manual pattern learning experiences, where undergraduates are instantaneously involved in the advancement of career dedicated learning, will hopefully instruct an education beyond a reliance on just technology for current students.

It is not debatable that technological skills are indispensable for the future of garment manufacturing in the fashion industry. There are frequent new developments in technology, patternmaking systems are regularly updated, and three-dimensional body scanning is available to aid in digitally rendered patternmaking and design (Pritchard, 2013), and even though Chinese factories are leading the global supply of manufactured garments by standard, price and speed, the possibility of factories and clothing manufacture to be re-introduced locally is possible. Such an initiation could inspire future generations to acquire manual patternmaking skills and this could also be re-established as an integral part of fashion design training.

This means that with the approach of a fourth industrial revolution, higher education will need to adjust classic modules while preserving industry knowledge. Teaching pattern design curriculums will require reconsiderations that include training in technology, and the accommodation of both manual and computer-assisted methods for this field. Regarding training of technical skills in pattern making and the upholding of these skills, multi-method approaches, and apprenticeship schemes are possibilities. From the evidence gained throughout this research alternative ideas for training future patternmakers could include a

collective learning setting. A multi-method approach where students are involved in the progression of a career-orientated learning experience, including digital grading short courses and manual pattern training, will prepare them for the technological world that they are about to enter, yet preserve hand-skills. When teaching digital patternmaking or grading, it would however, require a lecturer who is educated and knowledgeable with traditional manual patternmaking principles to uphold interpretation of silhouette and proportion. Training on a technological programme also requires class time, and the necessary equipment in order to put together a valuable and accredited course in higher education. Course development commands practice, experience and time. Without that, the recommendations remain theory only.

Another multi-method approach is to divide the course into two pathways. Commercial design studies that allow students to focus on digital pattern making, the creation of tech-packs and requirements that feed into the manufacturing side of fashion. Contrary to that a more classic pathway could include manual patternmaking and tailormade garment construction. With overlapping courses in these pathways, the students could at times work together, yet follow a specialised course. Students could respectively enrich the other's proficiencies, mimicking the industrial world of fashion, as well as couture fashion. Collaborations between the streams, with focused teamwork tasks between designers, patternmakers, and machinists will lift the standards of all the speciality fields involved.

More research to answer the new question that has emerged during the research process includes:

- Researching global manufacturers that mass produce in comparison with specialised designers globally in order to interview pattern cutters and analyse patternmaking methods aligned to different industry requirements. This will further explore training opportunities in the field of pattern design; and
- Exploring the skills of pattern designers in South Africa with greater depth, by carrying out larger practical studies locally, and investigating further into practical and technological pattern needs locally.

Disclaimer

I, Annelize Scheepers, declare that this paper, which I hereby submit to DEFSA for publication, is my own work. This paper is derived from a study in 2020, where pattern design methodologies were compared to inform the design education offering on a tertiary level.

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