

Analytical Study of the Smartphone Application (CloStyler Lite) and Utilizing it in Drafting and Fitting Clothing Patterns

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مجلة البحوث في مجالات التربية النوعية

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Analytical Study of the Smartphone Application (CloStyler Lite) and Utilizing it in Drafting and Fitting Clothing Patterns

Abstract: Beginners in the apparel industry sector have challenges in creating garment patterns, as it requires great experience and skill. Therefore, this research aims at analyzing the Clostyler Lite App, one of the smartphone applications used in drafting clothing patterns to empower those beginners to draft patterns easily. Accordingly, the applied study was divided into two components: an analytical study and an empirical study. The analytical study aimed to analyze the characteristics of the Clostyler Lite application to study its features and its use obstacles. Based on this study, it was concluded that the CloStyler Lite application is characterized by many features, such as including various methods for pattern drafting and the possibility of drafting many patterns of clothing pieces, and its easy and clear steps for drafting basic patterns for women's clothing. Besides, some modifications have also been suggested to develop the application so that it can be easily used by these beginners. Therefore, the empirical study has been conducted using the Clostyler Lite App. The skirt pattern was drafted in three sizes (small, medium, and large). A questionnaire was prepared to evaluate the fitting of the skirt pattern. Besides using Marvelous 12 software strain maps to measure how well a garment fits on the body. The results concluded that the skirt pattern achieved a high degree of fitting and conformity to the body.

Keyword: Smartphone Applications, CloStyler Lite App, CloStyler App, Pattern Drafting, Clothing Patterns.

دراسة تحليلية لتطبيق الهاتف الذكي (CloStyler Lite) والاستفادة منه في بناء وضبط النماذج

المخلص: يواجه المبتدئون في مجال صناعة الملابس صعوبة عند البدء في عملية بناء النماذج وإعدادها، حيث تتطلب خبرة ومهارة كبيرة، لذلك يهدف هذا البحث إلى الاستفادة من تطبيق Clostyler Lite لتمكين هؤلاء المبتدئين من رسم النماذج بسهولة ويسر، وبناءً عليه فقد انقسمت الدراسة التطبيقية إلى جزئين وهما دراسة تحليلية ودراسة تجريبية، حيث هدفت الدراسة التحليلية إلى تحليل خصائص تطبيق Clostyler Lite للتعرف على أهم مزاياه ومعوقات استخدامه، ومن خلال هذه الدراسة تم التوصل إلى أن تطبيق CloStyler Lite يتميز بخصائص عديدة، أهمها اشتماله على طرق مختلفة لإعداد النماذج وإمكانية رسم العديد من أنماط قطع الملابس، بالإضافة إلى الخطوات السهلة والواضحة لرسم النماذج الأساسية للملابس النساء، وبالرغم من ذلك فقد وجدت الباحثات بعض المعوقات عند استخدام التطبيق وبناءً عليه تم اقتراح بعض التعديلات لتطوير التطبيق حتى يتمكن المبتدئون من استخدامه بسهولة، كما تم إجراء الدراسة التجريبية لقياس ضبط نموذج الجونلة المعد باستخدام تطبيق CloStyler Lite، حيث تم رسم نموذج الجونلة لثلاثة مقاسات (small, medium, and large) وتم إعداد استبانة لتقييم ضبط نموذج الجونلة وعرضها على الأساتذة المتخصصين لإبداء الرأي فيها، كما تم استخدام خرائط الضبط بتطبيق Marvelous 12 لقياس ضبط نموذج الجونلة على الجسم للمقاسات الثلاثة، وقد توصلت النتائج إلى أن نموذج الجونلة المعد باستخدام تطبيق CloStyler Lite حقق درجة عالية من الضبط والمطابقة على الجسم.

الكلمات المفتاحية: تطبيقات الهاتف الذكي، تطبيق CloStyler Lite، تطبيق CloStyler، بناء النماذج، نماذج الملابس.

1. Introduction

Mobile phones are increasingly being used worldwide; smartphones and tablets have become more powerful and popular. These devices can provide diverse information in various fields, including business, finance, personal matters, and so forth (Glaser, 2014)¹, in addition to practicing many educational, training and shopping activities (Correia et al., 2024) (Alzamzami et al., 2023). Due to the increasing popularity of mobile phones, especially smartphones, which are characterized by their portability, the ability to store information, browse the internet, control daily activities and easily install the applications needed by the user (Shereitah, 2017) (Abdulwali et al., 2021) (Ahsan et al., 2021) (Susanto et al., 2021), programming phone applications have become very important, as the past decade has witnessed the rapid development of small programs known as “applications” that run on smart devices such as smartphones (Tom, 2013). Consequently, the race continues to construct applications that match the tremendous developments in these smartphones on the one hand, and meet different user needs on the other hand (Saleh, 2014) (Correia et al., 2023).

Application developers have developed numerous smartphone applications that serve various fields, especially clothing production. On the Google Store, we can find diverse applications, some of which focus on producing decorative designs and modifying them, while others deal with creating embroidery and cross-stitch drawings. Some applications showcase crochet and knitting patterns, explaining how to understand and implement them, while others address fabric and design coordination to suit different clothing purposes. The peak of development in this field is the creation of some applications concerned with making patterns for some clothing items in a simplified manner to assist beginners who lack knowledge of pattern-making methods or those who want to obtain patterns in a simple and quick way (Google App Store: 2023).

¹ The researchers used the APA system 7th edition in reference citation.

The pattern-drafting stage is one of the most critical stages in clothing production, as it falls between the design and implementation phases. The quality of the garment depends on this stage, including fit, comfort, and conformity to the body (Ibrahim & Mehran, 2016). Therefore, studying the basics of pattern making is essential. The research gap lies in the fact that pattern drafting requires a high degree of precision, expertise, and competence to prepare a good and accurate pattern. Additionally, the diversity of pattern types and preparation methods necessitates guidance at each step of the pattern-making process (Abdulwali et al., 2021). This kind of study is usually available in specialized institutes and universities that require specific admission criteria and a certain number of years of study. Alternatively, it may be offered in some training centers at high prices, making it challenging for many beginners in the clothing production field to enter the labor market at the beginning of their business journey. This often hinders and sometimes discourages them from pursuing this career path. Therefore, the idea of this research emerged from the modern technology in the field of mobile phones and the diverse applications in pattern making, aiming to explore the possibility of benefiting from the available applications via smartphones that specialize in pattern making to assist beginners.

2- Literature Review

Several studies have addressed smartphone applications and their utilization for educational and training purposes, especially in clothing production fields. The study by Hamzah (2015) aimed at evaluating the efficiency of a drawing program (Sketchbook for Galaxy) available on the Google Play application store and produced by Autodesk. The objective was to enrich fashion design through an application that offers the advantages of electronic design while enhancing the trainees' skills and techniques in manual design and drawing. The application also allows them to practice the design process anytime, anywhere, avoiding the high expenses of sketchbooks and drawing tools. The researcher concluded that this application achieved a high relative value regarding its capabilities and general features, the efficiency of its

tools and commands, and the quality of the designs implemented through it. Another study by Solaiman (2019) aimed at designing a dictionary of clothing and textile terms using smartphone applications to benefit researchers and students in the field of clothing and textiles. In addition to the study of Salem et al. (2013), which aimed to introduce a smartphone-based training system specifically designed to develop fashion and textile knowledge among female students with severe hearing impairment, their findings indicated that this mobile training system was successful in enhancing the students' understanding of fashion and textile concepts. The study by Zakharkevich et al. (2020) aimed to examine different examples of mobile phone applications during the educational simulation of a design product to monitor students' work remotely. The applications included Pinterest, SCANN3D, True Sculptor, d3D Sculptor, and Realtime Board. The study concluded that mobile phone technologies attract students at various stages of project development up to the final product. Additionally, Al-Salman (2020) conducted a study titled "Employing Smartphone Applications in Developing Students' Skills in Embroidery Techniques." This study aimed at developing students' skills in embroidery techniques using smartphone applications, leading to increased efficiency in the educational process. The findings of the study emphasized the effectiveness of smartphone applications in developing students' skills in embroidery techniques. Likewise, Mousa (2022) conducted a study titled "The Effectiveness of the Electronic Application Fashion Design Flat Sketch App in Teaching Fashion Design for Graduates in the Field of Fashion Industry to Keep up with the Labor Market." This study aimed to teach fashion design to graduates from various colleges and institutes not specialized in the fashion industry, contributing to providing job opportunities and addressing the problem of unemployment. This aligns with the current study, which aims to empower beginners in the clothing production field to prepare patterns by following simple and straightforward steps, qualifying them to enter the labor market. Another study of Zakharkevich et al. (2023) develops a mobile app, "TechLab." The app supports learning sewing techniques of leather and fur garment manufacturing. Using a

mobile app helps students achieve the core learning outcomes. An expert panel, comprising teachers, garment industry students, and clothing designers, evaluated the app. Survey results indicated that TechLab demonstrated strong potential as a learning tool in this field.

Besides, the study by Idrees et al. (2023) explored the strengths and weaknesses of mobile body scanning applications. They analyzed 18 different 3D scanning apps and found that the scanning process is fast and convenient. These apps offer a variety of features, including digital measurements for customized clothing, virtual try-on and dressing room experiences, and body tracking features like body fat monitoring, surface area calculation, and BMI estimation. These functionalities empower users to personalize their online shopping experience by selecting perfectly fitting garments. Zakharkevich et al. (2021) also aimed to create a mobile application that empowers users with computational and graphic shoe design tools. This app will be valuable in both footwear production and education. To achieve this, the market of mobile apps for shoe design and manufacturing has been analyzed to gain valuable insights for our own development, develop a prototype based on the market analysis, and then it has been tested and evaluated to ensure it meets its goals. Curipaco et al. (2023) propose an application that utilizes image processing and convolutional neural networks (CNNs) to generate personalized dress garment patterns based on photos. Users simply need to provide frontal and side-view photos along with their height. The application then employs CNN technology to analyze the images and extract body measurements. Finally, these measurements are used to adjust existing garment patterns, resulting in customized pattern dimensions for a perfectly tailored dress. Similarly, the study by Foysal et al. (2021) proposes an interactive smartphone application called "SmartFit." This app utilizes image processing and machine learning to detect consumers' body shapes based on smartphone images. Consequently, it provides recommendations for clothing with optimal fit. A preliminary assessment of the developed model shows an accuracy of 87.50% for body shape detection, suggesting a promising solution to the persistent problem of fit

detection in the digital apparel market. Another study of Oehlschläger et al. (2022) investigated the potential of a smartphone app to digitally match individuals with clothing items in an organizational setting. The app's ability to measure body dimensions and recommend product sizes was tested compared with a laser-based 3D scanner. German Armed Forces personnel used the app to scan themselves, and the resulting data was used to select clothing items from a simulated online store. Participants then tried on the chosen items, and fit was assessed by both the participants and clothing experts. The study found that the smartphone app is a viable tool for digitizing the outfitting process; it also highlighted challenges in current product sizing and the need for gender-specific clothing, as unisex options performed poorly for women. Overall, the research identified both the strengths and weaknesses of the smartphone app and the digital outfitting system as a whole.

There is also a recent study conducted by Jalil et al. (2022) that introduced EcoChildClo, a mobile app that empowers users to design custom clothing for children aged 1-12. This innovative app goes beyond just designs. It provides previews of clothing samples, flat sketches, and made-to-measure flat patterns. Compared to other apps, EcoChildClo is able to make the basic blocks of custom children's clothing. With EcoChildClo, anyone can design clothes according to an individual's height, body measurement, and body shape. Which contributes to a more sustainable future by reducing textile waste from ill-fitting clothes. Another study was also conducted by Jalil et al. (2023) on the same application, EcoChildCLO, to evaluate its effectiveness as a training tool for children's clothing patternmaking. The two key advantages of the app are to enable users without prior experience to create patterns and reduce fabric waste, which promotes sustainability. The results indicate that the app effectively teaches patternmaking, making it accessible to both beginners and experienced designers. Over half of the students positively received the app as a training tool; therefore, research contributes to understanding pattern-cutting and children's apparel design education. Moreover, Abu Hashima (2022) conducted a study on the JSK Patrones application; the objective was to

evaluate the fitting of the bodice block pattern for women drafted with the JSK Patrones app. After drafting and implementing it on fabric in multiple sizes, the study suggested some modifications for the bodice block pattern, and the results proved the feasibility of using the studied mobile phone application in drafting the basic pattern for the women's bodice block with some modifications to achieve a high degree of fit and comfort. Another study on the JSK Patrones app of Youssef (2023), which aimed to use the JSK Patrones app in drafting a basic trouser block pattern and evaluating its fitting to the body, where it came up with some modifications that can be carried out to the pattern to achieve a high degree of fitting to the body. Besides, the study of Zakharkevich et al. (2021), who compared pattern drafting applications in their study, which aimed to develop the "CloStyler" application and conduct an analytical study to compare it with a number of applications already on the market (Circleskirt Calculator, Chalk, JSK Patrones, Solo Patrones App) to determine the level of competitiveness of the application, showed The results are that "CloStyler" is more suitable and better equipped for the task of calculating the basic parameters of clothing blocks, in addition to being able to be used in pattern drafting for many types of garments. These studies align with the current research, which focuses on studying smartphone applications used in pattern making.

Despite many studies addressing various mobile phone applications and their uses in the clothing industry, it has been observed that the majority of these studies are concerned with the fields of student education and training. None of these studies addressed beginners who have a lack of knowledge and experience in the field of pattern drafting and need support to start their projects in the field of clothing production, especially since learning the steps of pattern drafting requires years of study and experience in specialized institutes and centers until the student and trainee reach a sufficient degree of skill and mastery. Hence, the novelty of this study is that it is concerned with analyzing the Clostyler Lite App, one of the smartphone applications used in drafting clothing patterns to recognize its features and problems to make use by beginners, besides suggesting some appropriate

modifications that help beginners to draft patterns fitted to the body in an easy and simplified way.

Research Objectives

- Analyze the characteristics of the Clostyler Lite application as one of the smartphone applications used in drafting clothing patterns to identify its features and obstacles to users.
- Suggest some adjustments to the problems that users may face during drafting patterns using the Clostyler Lite application.
- Verify the adjustment of the skirt model and its conformity to the body for the three sizes (S, M, and L).

Research Importance

- Utilizing innovations and contemporary technologies of smartphone applications within the apparel sector.
- The results of this research may contribute to the development of beginners in small and medium enterprises in the ready-made clothing sector.

Research hypotheses

- There are statistically significant differences among the arbitrators' judgments about the assessment of the skirt pattern fitting on the virtual mannequin (size S) for each fitting aspect.
- There are statistically significant differences among the arbitrators' judgments about the assessment of the skirt pattern fitting on the virtual mannequin (size M) for each fitting aspect.
- There are statistically significant differences among the arbitrators' judgments about the assessment of the skirt pattern fitting on the virtual mannequin (size L) for each fitting aspect.

Research Terminology

- *Smartphone:*

A smartphone is a cell phone with a built-in computer that uses an advanced operating system. Mobile phones offer users various capabilities, including text and voice communication, playing

audio and video files, digital cameras, GPS (Al-Sawy, 2019) (Yus, 2021) (Xu, 2019), internet browsing on the go, synchronizing appointments, calendars, contacts, and email, opening Office files, and installing user-chosen applications. Smartphones also support user productivity and can be customized to assist in required tasks by adding specialized applications that can be programmed to respond automatically to major work events (Himmelsbach, 2012).

- ***Smartphone Applications:***

A smartphone application is a program designed to run on a mobile device connected to the internet. It is characterized by its simplicity and ease of use for users. The most common applications include social networking, email, text and video chat, search engines, storage, and file sharing (Al-Abhari, 2021) (Nisar, 2019). These applications have also played an important and effective role in education and training (Al-Adiani, 2019) (Moukly, 2020).

- ***Pattern:***

A pattern is a sketch of a garment containing a set of straight, curved, and slanted lines. It is made using precise body measurements so that it can be drafted on paper and then cut from a sufficient piece of fabric (Karthik, Ganesan, & Gopalakrishnan, 2016) (Armstrong, 2014).

3- Methodology (Practical Framework)

Based on the study conducted by Zakharkevich et al. (2021), which analyzed pattern drafting applications, "CloStyler" is deemed more appropriate and proficient for calculating the fundamental mass parameters of clothing, as well as for drafting patterns for various garment types using multiple pattern drafting methods (Zakharkevich, 2021). Consequently, the current study identified the "CloStyler Lite" app as a viable alternative to the "CloStyler" app, owing to its unique attributes, including being freeware, offering multiple pattern drafting methods, and enabling the drafting of various clothing items via smartphones without internet connectivity, thereby assisting novices and individuals

with limited experience in the apparel production sector to initiate their enterprises. The study was divided into two parts:

3.1. Analytical Study

The “CloStyler Lite” app was analyzed to identify the possibility of utilizing it in drafting women’s patterns for beginners and the problems they may face when using the app. The app can be found at:

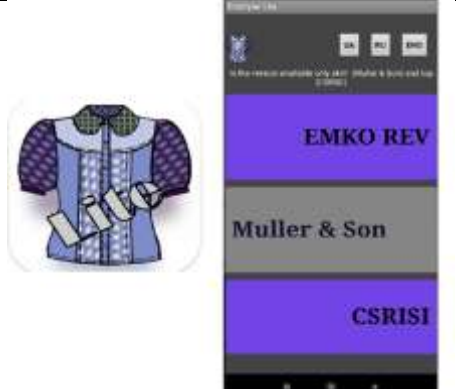
https://play.google.com/store/apps/details?id=appinventor.ai_zbir_yukladach.CloStylerLight for Android.


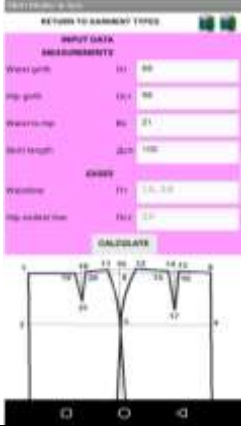

Based on this analytical investigation, the application's capabilities for beginners were determined, as well as proposing some solutions for developing the application for beginner use.

3.2. Empirical Study

3.2.1 Drafting the basic pattern for the available garment pieces on the CloStyler Lite app (bodice block, skirt, etc.) using three sizes for each piece. These sizes are small, medium, and large according to the standard body measurements of Aldrich (Aldrich, 2015). The Steps for Drafting a Pattern Using the CloStyler Lite application shown in Table 1.

Table 1: The Steps for Drafting a Pattern Using the CloStyler Lite application

Steps	Process	Illustrated shots from the application
Step 1	launching the app by clicking the icon, then the following screen appears showing the pattern drafting methods.	

<p>Step 2</p>	<p>Choosing the desired pattern drafting method, such as the Muller & Sohn method, then choosing the garment type, such as skirt.</p>	
<p>Step 3</p>	<p>Entering the measurements and the amount of eases according to the desired size.</p>	
<p>Step 4</p>	<p>clicking on the Calculate button, following the instructions specified by the app, and then we reach the drafted pattern.</p>	

- 3.2.2 Simulate the drafted patterns using the Marvelous Designer 12 software to check their fit and conformity to the body.
- 3.2.3 Evaluating the drafted patterns through specialists in the clothing industry and also using strain maps to evaluate fitting to the body.

4- Results and Discussion

4.1. Analytical Study Results:

4.1.1. CloStyler Lite Application features

The CloStyler Lite application's goal is to calculate the parameters of the basic blocks of clothing; this lite version calculates two garment types: skirt and bodice blocks. The app's pro edition enables users to calculate clothing blocks' parameters by three different methods of pattern drafting (EMKO REV, Muller & Sohn, and CSRISI). There are eight different garment types available in the app: a bodice block, pants, a suit jacket, a jacket, a skirt, a dress, a blouse, and a shirt. The available languages are English, Russian, and Ukrainian. Users can select both a garment type and a pattern drafting method. The amount of eases and the body measurements are the input data that are employed in the calculation of the pattern parameters since the user enters them in the app, and then the app will calculate the pattern parameters.

4.1.2. Some obstacles noted by the researchers when analyzing the CloStyler Lite App

4.1.1 The application is limited in use, as it contains only two open-access methods for pattern drafting. The first method (Muller & Sohn) allows access to the skirt pattern only, and the second method (CSRISI) allows access to the bodice block pattern only. Therefore, the researchers suggest that beginners, after trying the limited version, purchase the fully supported version, as it is inexpensive and contains three methods for pattern drafting, in addition to calculating parameters for eight different pieces of clothing.

4.1.2 The researchers tried the two methods of pattern drafting included in the app, it was generally noted that the German method (Muller & Sohn) is easier than the Russian method (CSRISI) in terms of the ease of the measurements included, the smoothness of the steps, and the ease of applying them.

4.1.3 The researchers drafted the skirt pattern using the German method (Muller & Sohn) using the application, they found that the calculation of the amount of darts isn't accurate, the application calculates the amount of the back and front darts as a fixed value of 5 cm in step No. 7, although it leaves the value of the back dart is at a range of 3 to 4 cm in step No. 10, and the value of the front dart is at to a range of 1.5 to 2.5 cm in step No. 13, and

accordingly the researchers suggest fixing the value of the back dart in step No. 10 at a value of 3 cm, and fixing the value of the front dart in step No. 10 at a value of 2 cm, so that the sum of the values of the two darts, the back and the front, is 5 cm, which equals the amount mentioned previously in step No. 7.




4.1.4 Through the researchers' background in pattern drafting, they have observed that the CSRISI method requires some measurements, which are difficult for beginners to understand easily. For example, when drafting the bodice block pattern using this method, three measurements of girth (half of over bust girth, half of bust girth 2, and half of bust girth 3) are required. Therefore, the researchers suggest adding an illustrated icon next to each required measurement explaining the method of taking this measurement so that it can be obtained easily and accurately.

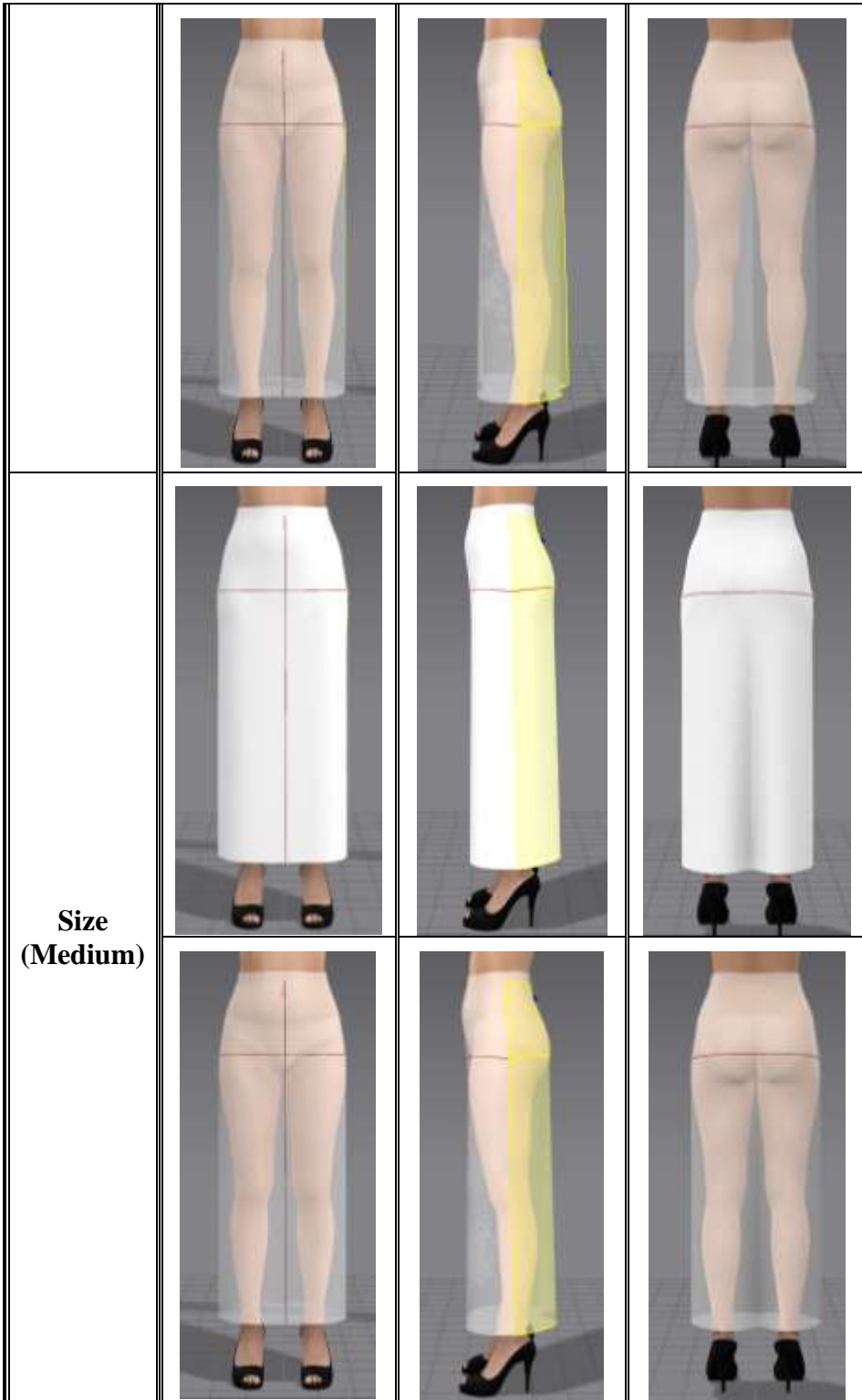
Hence, beginners can use the application to draft simple clothing patterns with these proposed adjustments, which enables them to start their work, and this is consistent with the study of Zhylenko et al. (2019) that developed a mobile application for the urgent and rapid calculation of parameters to design basic blocks of the clothing patterns. The patterns might be constructed directly on the fashion fabric by using the developed mobile app as a calculator and notepad. The precision of the calculation is the same as that of other calculation methods, while the risk of accidental mistakes due to the human factor is excluded from the designing process. Clothing designers can use it as well as students for training in their study of clothing design. It is a useful tool for the people who make their living on garment design for individual customers or like to sew for themselves. The calculation of parameters is determined quickly and without economic costs. Thus, the main objective of the study was achieved through developing the mobile application to calculate the parameters of clothing basic blocks, and by doing so, the support of the weakly automated clothing design process in tailor shops and other small clothing design enterprises was ensured.

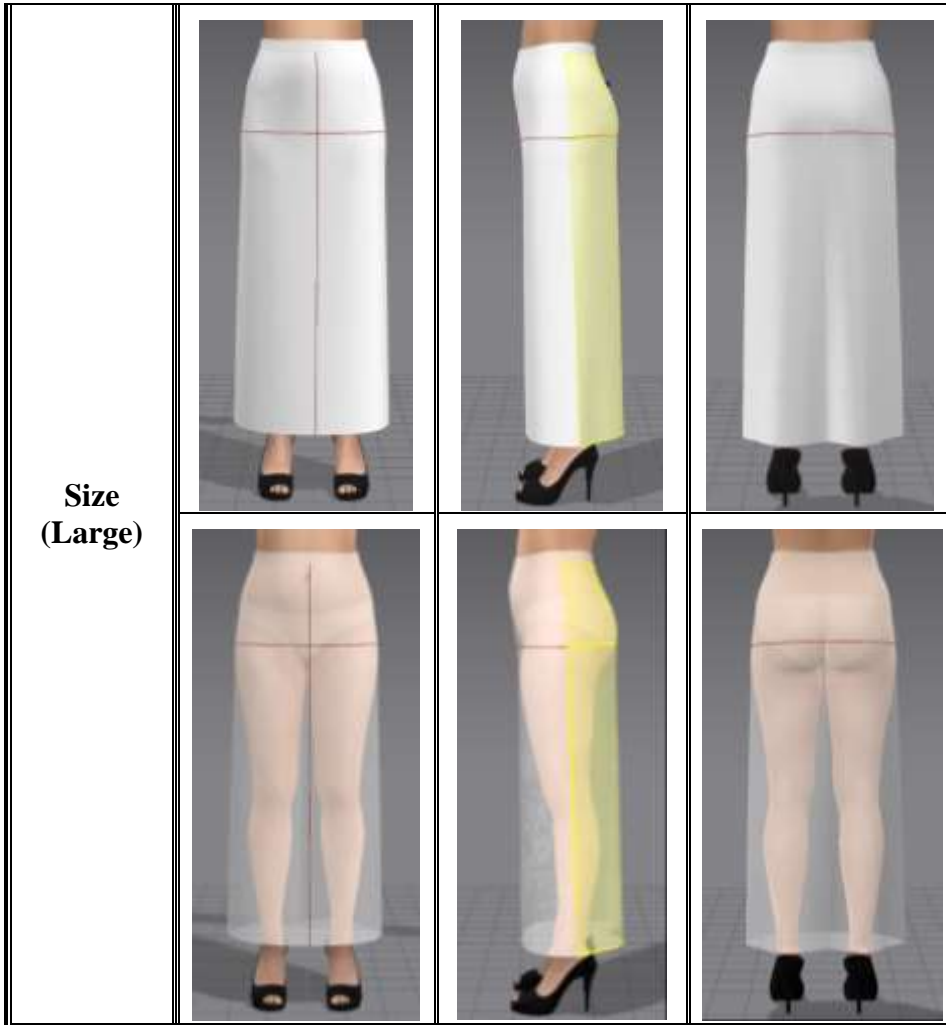
4.2. Empirical Study Results:

4.2.1 The empirical study was conducted using the CloSyler Lite application. The researchers picked the Muller method, which is one of the pattern-drafting methods offered in the application. The researchers chose to draft the pattern of the skirt. Marvelous Designer 12 software (one of the pattern-drafting simulation softwares) was used to draft the skirt pattern as followed in the CloSyler Lite app and simulate it on the avatar. The skirt pattern has been drafted in three different sizes, which are small, medium, and large, according to the standard body measurements of Aldrich (Aldrich, 2015). The simulation of the skirt pattern on the avatar is shown in Table2.

Table 2: shows the simulation of skirt pattern with three sizes

	Front	Side	Back
Size (Small)			





4.2.2 The skirt pattern was judged (after simulating it using Marvelous software) by a group of clothing specialists to evaluate the pattern's fitting and its conformity to the body, where they expressed their opinion on the skirt pattern through responding to the questionnaire shown in Table 3.

Table 3: the questionnaire used to evaluate the fitting of the skirt pattern

Fit Elements		Size (Small)			Size (Medium)			Size (Large)		
		suitable	To some extent	unsuitable	suitable	To some extent	unsuitable	suitable	To some extent	unsuitable
Drapability										
Balance										
Amount of Ease	From waistline to Abdomen									
	From abdomen to hip line									
Lines	Center front line									
	Center back line									
	Waistline									
	Hip line									
	Hem line									
	Side seam									

It is clear from the judges' evaluation of the skirt pattern fitting to the body that the skirt pattern drafted using the CloStyler Lite application achieved high levels of fitting for the three sizes, as shown in the simulated images of the skirt patterns. Accordingly, the skirt pattern drafted with the CloStyler app does not need any modifications, which makes it easy for beginners to use in drafting the skirt pattern.

4.2.3 A Likert scale was used to express degrees of agreement with questionnaire statements using the SPSS statistical program, and the results were analyzed by determining the categories of the tripartite scale. When the weighted mean is confined between 1:1.66, it will be unsuitable, from 1.67:2.33 to some extent, and from 2.33:3 suitable.

4.2.4 The weighted mean and relative value of the fit elements were calculated for the three sizes of the skirt pattern, as shown in Tables 4, 5, and 6.

Table 4: The Weighted Mean and Relative value of Fit Elements for Size (Small) of the Skirt Pattern

Fit Elements	Suitable		To some Extent		unsuitable		Weighted Mean	Relative Value %	Description	
	N	%	N	%	N	%				
Drapability	11	78.57	3	32.43	0	0	2.78	92.85	suitable	
Balance	13	92.85	1	7.15	0	0	2.92	97.61	suitable	
Amount of Ease	From waistline to abdomen	9	64.28	5	35.72	0	0	2.64	88.00	suitable
	From abdomen to hip line	10	71.42	4	28.58	0	0	2.71	90.47	suitable
Lines	Center front line	12	85.71	2	14.29	0	0	2.85	95.23	suitable
	Center back line	13	92.85	1	7.15	0	0	2.92	97.61	suitable
	Waistline	9	64.28	5	35.72	0	0	2.64	88.00	suitable
	Hip line	14	100	0	0	0	0	3.00	100.00	suitable
	Hem line	12	85.71	2	14.29	0	0	2.85	95.23	suitable
	Side seam	11	78.57	3	32.43	0	0	2.78	92.85	suitable
All Fit Elements							2.81	93.79	suitable	

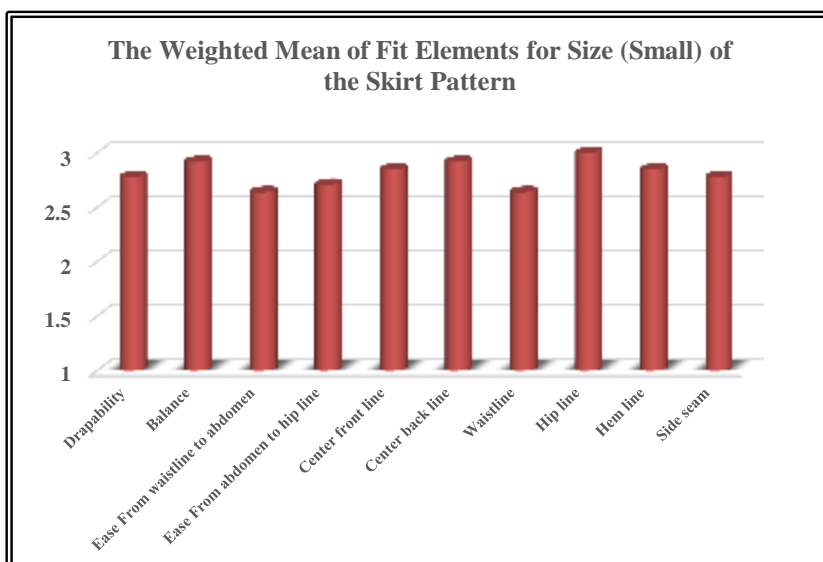
**Figure 1: The Weighted Mean of Fit Elements for Size (Small) of the Skirt Pattern**

Table 4 and Figure 1 show the consensus among the judges about the questionnaire items for size Small. The first item (drape) attained an agreement rate of 92.85%, the second item (balance) attained an agreement rate of 97.61%, the third item (the amount

of comfort from the waist to the abdomen) attained an agreement rate of 88%, the fourth item (the amount of comfort from the abdomen to the hip line) attained an agreement rate of 90.47%, the fifth item (the center front line) attained an agreement rate of 95.23%, the sixth item (the center back line) attained an agreement rate of 97.61%, the seventh item (the waist line) was appropriate with an agreement rate of 88%, the eighth item (the hip line) attained an agreement rate of 100%, the ninth item (the hem line) attained an agreement rate of 95.23%, and the tenth item (the side seam line) was appropriate with an agreement rate of 92.85%. The consensus among judges about the questionnaire items in size Small is 93.79%, which is deemed acceptable.

Table 5: Weighted Mean and Relative value of Fit Elements for Size (Medium) of the Skirt Pattern

Fit Elements		suitable		To some extent		unsuitable		Weighted Mean	Relative Value %	Description
		N	%	N	%	N	%			
Drapability		12	85.71	2	14.29	0	0	2.85	95.23	suitable
Balance		14	100	0	0	0	0	3.00	100	suitable
Amount of Ease	From waistline to abdomen	7	50	7	50	0	0	2.50	83.33	suitable
	From abdomen to hip line	13	92.85	1	7.15	0	0	2.92	97.61	suitable
Lines	Center front line	12	85.71	2	14.29	0	0	2.85	95.23	suitable
	Center back line	11	78.57	3	32.43	0	0	2.78	92.85	suitable
	Waistline	12	85.71	2	14.29	0	0	2.85	95.23	suitable
	Hip line	13	92.85	1	7.15	0	0	2.92	97.61	suitable
	Hem line	11	78.57	3	32.43	0	0	2.78	92.85	suitable
	Side seam	13	92.85	1	7.15	0	0	2.92	97.61	suitable
All Fit Elements								2.84	94.76	suitable

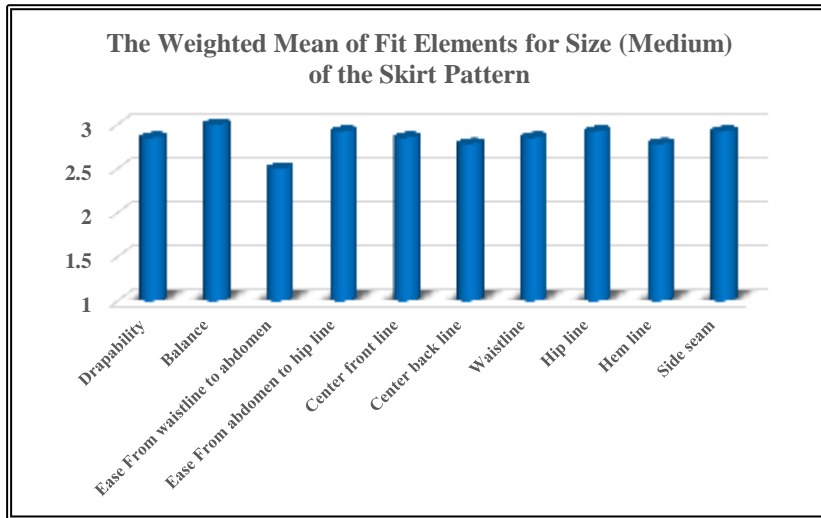


Figure 2: The Weighted Mean of Fit Elements for Size (Medium) of the Skirt Pattern

Table 5 and Figure 2 show the consensus among the judges about the questionnaire items for size Medium. The first item (drape) attained an agreement rate of 95.23%, the second item (balance) attained an agreement rate of 100%, the third item (the amount of comfort from the waist to the abdomen) attained an agreement rate of 83.33%, the fourth item (the amount of comfort from the abdomen to the hip line) attained an agreement rate of 97.61%, the fifth item (the center front line) attained an agreement rate of 95.23%, the sixth item (the center back line) attained an agreement rate of 92.85%, the seventh item (the waist line) was appropriate with an agreement rate of 95.23%, the eighth item (the hip line) attained an agreement rate of 97.61%, the ninth item (the hem line) attained an agreement rate of 92.85%, and the tenth item (the side seam line) was appropriate with an agreement rate of 97.61%. The consensus among judges about the questionnaire items in size Medium is 94.76%, which is deemed acceptable.

Table 6: Weighted Mean and Relative value of Fit Elements for Size (Large) of the Skirt Pattern

Fit Elements		suitable		To some extent		unsuitable		Weighted Mean	Relative Value %	Description
		N	%	N	%	N	%			
Drapability		12	85.71	2	14.29	0	0	2.85	95.23	suitable
Balance		10	71.42	4	28.58	0	0	2.71	90.47	suitable
Amount of Ease	From waistline to abdomen	9	64.28	5	35.72	0	0	2.64	88.00	suitable
	From abdomen to hip line	12	85.71	2	14.29	0	0	2.85	95.23	suitable
Lines	Center front line	13	92.85	1	7.15	0	0	2.92	97.61	suitable
	Center back line	14	100	0	0	0	0	3.00	100.00	suitable
	Waistline	13	92.85	1	7.15	0	0	2.92	97.61	suitable
	Hip line	7	50	7	50	0	0	2.50	83.33	suitable
	Hem line	13	92.85	1	7.15	0	0	2.92	97.61	suitable
	Side seam	9	64.28	5	35.72	0	0	2.64	88.00	suitable
All Fit Elements								2.80	93.31	Suitable

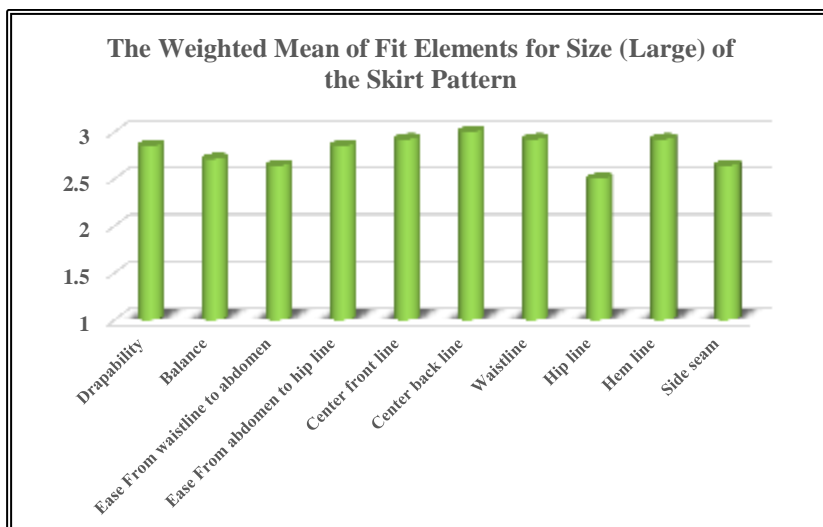
**Figure 3: The Weighted Mean of Fit Elements for Size (Large) of the Skirt Pattern**

Table 6 and Figure 3 show the consensus among the judges about the questionnaire items for size Large. The first item (drape) attained an agreement rate of 95.23%, the second item (balance) attained an agreement rate of 90.47%, the third item (the amount of comfort from the waist to the abdomen) attained an agreement

rate of 88%, the fourth item (the amount of comfort from the abdomen to the hip line) attained an agreement rate of 95.23%, the fifth item (the center front line) attained an agreement rate of 97.61%, the sixth item (the center back line) attained an agreement rate of 100%, the seventh item (the waist line) was appropriate with an agreement rate of 97.61%, the eighth item (the hip line) attained an agreement rate of 83.33%, the ninth item (the hem line) attained an agreement rate of 97.61%, and the tenth item (the side seam line) was appropriate with an agreement rate of 88%. The consensus among judges about the questionnaire items in size Large is 93.31%, which is deemed acceptable.

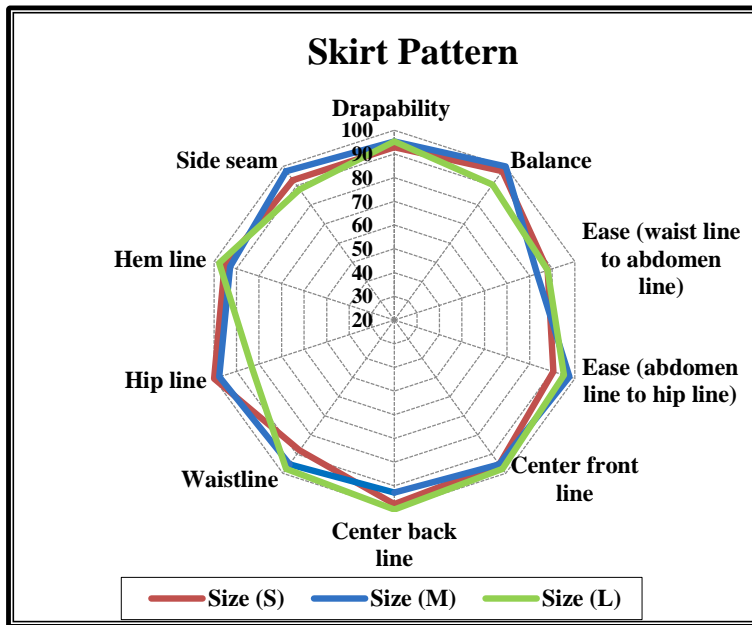


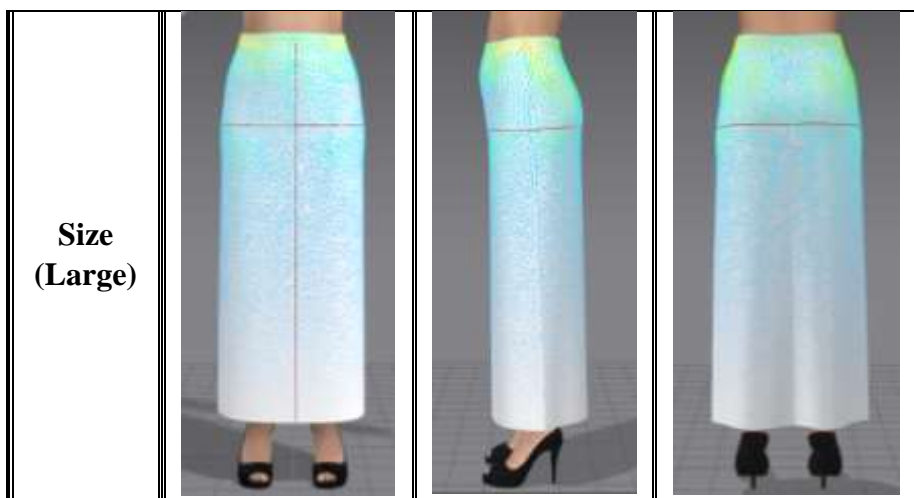
Figure 4: Rader chart for relative values % of Fit Elements for the Three Sizes of the Skirt Pattern

Tables 4, 5, 6, and Figure 4 show judges high evaluation scores for the fit elements of the skirt pattern, with quality coefficients ranging from 83.33% to 100%. Additionally, the quality coefficients for the combined fit elements are high for all three sizes (93.79%, 94.76%, and 93.31% for sizes S, M, and L, respectively), indicating that the skirt pattern achieved a high degree of fit and conformity to the body for all three sizes.

4.2.5 Fitting maps are used in Marvelous Designer 12 to measure how well a garment fits on the body. One of these maps is the strain map, which shows the tension on the garment while wearing it, the resulting distortion in the garment shape, or discomfort in wearing. Accordingly, the strain map was applied to the skirt pattern in the three sizes (small, medium, and large) to evaluate its fitting to the body. These images are shown in Table 7.

Table 7: shows the strain maps images for the skirt pattern with the three sizes (Small, Medium, and Large)

	Front	Side	Back
Size (Small)			
Size (Medium)			



It is clear from the strain maps for the three sizes that the blue color, which indicates the zero-strain value (no distortion), is spread over most of the skirt pattern, while the yellow color begins to appear very slightly on the sides of the waist area, indicating a distortion in the garment of 11.43%, which is a very slight percentage. This is logical because this area in the skirt pattern is exposed to greater body pressure, indicating that the skirt pattern drafted using the Clostyler Lite application achieves a high degree of fitting to the body for the three sizes. Accordingly, the opinions of the judges in evaluating the fitting of the skirt pattern for the three sizes agree with the results of the fitting evaluation using the Marvelous Designer 12 software using strain maps.

5 - Conclusion

The current study contributed to simplifying the pattern drafting process, potentially empowering beginners and those with insufficient experience in the clothing production field to break into the labor market. The researchers analyzed the Clostyler Lite smartphone app used in pattern drafting to identify features and obstacles of it.

By analyzing the features of the CloStyler Lite application, the researchers found that the app is perfect in calculating the parameters of the basic blocks of clothing; this lite version calculates two garment types: skirt and bodice blocks. The app's

pro edition enables users to calculate clothing blocks' parameters by three different methods of pattern drafting (EMKO REV, Muller & Sohn, and CSRISI); two of them are open-access methods for pattern drafting; the first method (Muller & Sohn) allows access to the skirt pattern only, and the second method (CSRISI) allows access to the bodice block pattern only. Therefore, the researchers suggest that beginners, after trying the limited version, purchase the fully supported version, as it is inexpensive and contains three methods for pattern drafting, in addition to calculating parameters for eight different pieces of clothing: a bodice block, pants, a suit jacket, a jacket, a skirt, a dress, a blouse, and a shirt. Users can select both a garment type and a pattern drafting method. The amount of eases and the body measurements are the input data that are employed in the calculation of the pattern parameters since the user enters them in the app, and then the app will calculate the pattern parameters; hence, beginners can use the application to draft simple clothing patterns with these proposed adjustments, which enables them to start their work.

The empirical study in this research revealed that the skirt pattern achieved a high degree of fit and conformity to the body. Additionally, the fit level of the pattern did not differ with the size, as sizes small, medium, and large yielded similar fit values, confirming the research objectives. These results align with the conclusions of previous studies that demonstrated the potential for employing smartphone applications in various clothing production fields, especially in the pattern drafting process.

6 - Recommendations

- Staying updated with the latest smartphone applications and exploring their benefits in the different stages of ready-to-wear clothing production.
- Organizing workshops and seminars to promote the use of smartphone applications in various clothing production fields.
- Conducting further research aimed at facilitating the different stages of clothing production for beginners and motivating them to enter the labor market.

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