IN SEARCH OF THE RIGHT TROUSER PATTERN
- COMPARISON OF FOUR DIFFERENT PATTEN MAKING MATTHODS IN AFFORDANCE WITH DIFFERENT BODY SHAPES

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Abstract: Clothing comfort is one of the major concerns in the clothing industry. Various pattern making methods have been introduced to the industry with consideration to clothing comfort. This study evaluates four pattern making methods known as the ESMOD, Bunka, Aldrich, and Armstrong methods. The work focuses on trouser patterns and uses two subjects who have similar height, weight and BMI but have different body shapes and body sizes. The body measurement data of the two subjects were collected using a three-dimensional body scanner and patterns of the four different methods were developed accordingly. The fit of experimental garments were examined by two subjects and experts using questionnaires and were analysed.

Keywords: Clothing comfort, Clothing fit, Fit preference, Fit evaluation

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1. INTRODUCTION

One of the aspects of competitiveness in the clothing industry is to have professional pattern making skills, combined with fit proper suitability for customers and a speedy clothing manufacturing system. The popularity of female choosing to wear trousers has been on the rise in comparison with that of wearing skirts, especially in our modern society. Increasing demands for trousers include not merely their functional aspects but also aesthetic aspects, physical suitability and movement adaptability, as well as for a variety of designs. In this sense, it is necessary to understand body shapes and to develop enhanced trouser pattern blocks which reflect the specific characteristics of different pattern making methods.

The aim of this study is to compare four different trouser pattern making methods with a focus on fit for different body shapes and to examine the characteristics of each pattern making method by producing, analysing and evaluating both real garments and three-dimensional virtual simulated garments. Experiments for fit evaluations were designed to achieve the study aim and the key questions to answers are as follows.

Q1. Which method is most suitable for each subject?
Q2. Do the results of the fit evaluation show the same satisfaction between subject A and B / real garments and three-dimensional simulated garments?

2. METHODS

Figure 1. shows the methodology used for this study. The process as it occurred is follows:
■ First, body sizes of two subject, referred to as subjects A and B, were measured using a three-dimensional scanner, [TC]². Each subject's body type was classified by BMI (Body Mass Index) and

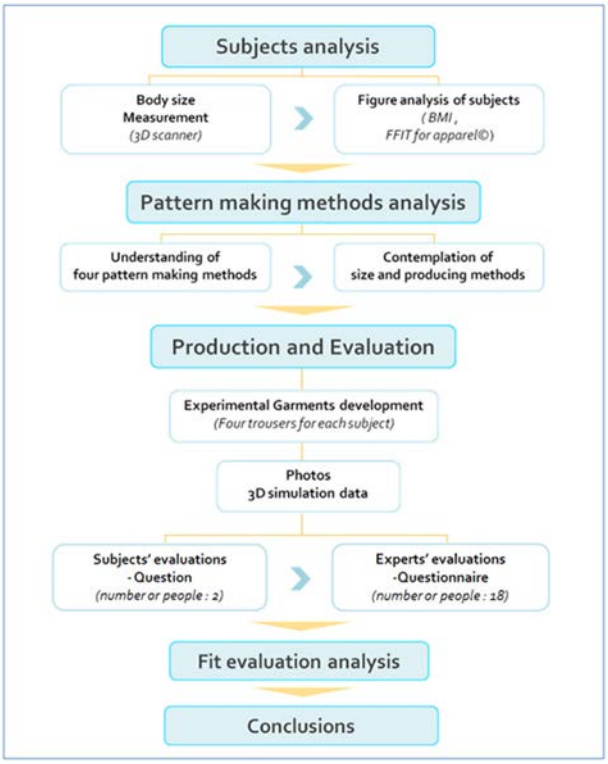


Figure 1. A schematic workflow of experimental process

Table 1. Body scan data of two subjects

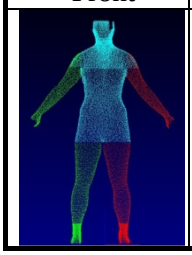
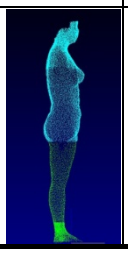
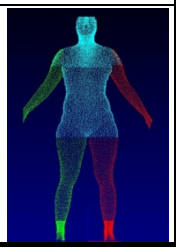
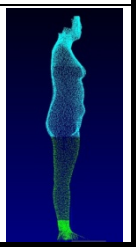
Subject A		Subject B	
Front	Side	Front	Side
			

Table 2. Considerations to make trouser

	Subject A	Subject B
Waist (Front)	75.9 cm	81.4 cm
Hip	101.9 cm	110 cm
Hip length	23.7 cm	24.6 cm
Crotch length	34.15cm	41.2cm
Height	167.7 cm	168 cm
Weight	68kg	69.2kg
BMI	24.18	24.52
Body shape	Hourglass	Bottom Hourglass

FFIT apparel©, 'Female figure identification technique (FFIT) for apparel©' developed by Devarajan and Istook (2004) for classifying body shape. ■ Second, books currently published and used in the academic field were selected for comparing the four pattern making methods (ESMOD, Bunka, Aldrich and Armstrong). ■ Third, experimental garments (which were designed by four pattern making methods using the fundamental body sizes of each subject) were developed. Trouser patterns were made using YUKA apparel CAD system (SuperALPHA: Plus) and pattern data was saved in a DXF file format. Cotton muslin (100%) was used to make the experimental garments after testing using the KES system. The experimental garment-making process was done in the same order as bespoke tailoring. Three-dimensional simulated garments were developed using 'i-designer' and, the transformed pattern data was saved in DXF file format in the YUKA CAD pattern program. Fabric property values were measured using the KES system and input to create three-dimensional shapes of experimental garments. ■ Fourth, appearance examinations were evaluated using 18 experts who had background knowledge of pattern making. The experts observed photos of the trouser fronts, sides, and backs. The appearances were judged through darts (length, position and the distance between darts position), amount of ease at each body part (waist, hip, abdomen, hip, crotch and thigh), and overall silhouette. A cross-examination exercise using 16 questions; ten for the front and back, four were used in reference to side, and two were extra/overall questions. A five-point scale rating method were used with responses ranging from 'very good=5', 'good=4', 'neutral=3', 'bad=2', 'very bad=1'. Three-dimensional simulated body figures of two subjects were produced through a three-dimensional simulation program by inputting the two subjects' body measurement sizes. The three-dimensional simulated images of each trouser front, sides and back with three-dimensional simulated body figures wearing four trousers were used in the appearance examinations. The experts, questions, and rating method used for the evaluation were the same as in experimental real garment examinations. ■ Fifth, Microsoft Excel 2007 and the

statistics program SPSS 11.0 were used to calculate the mean and standard deviation; these were conducted to verify significant differences in each part. ■ Sixth, the results of the fit evaluations were analysed.

3. RESULTS AND FINDINGS

3.1. Findings of Subjects

Table 1. shows each subject's three-dimensional body scanned data. Fundamental body sizes of each subject to make the trousers and division based on BMI and FFIT© are represented in Table 2. The two subjects who were chosen in this study have similar height, weight and BMI. However, they have predominant differences in hip size (8cm) which is almost a two size grading interval. In addition, their body shapes are different are being an Hourglass shape and the second a Bottom Hourglass shape. A total of eight experimental garments were produced. For the two subjects, four pattern methods for making trousers (ESMOD, Bunka, Aldrich, and Armstrong) were used to manufacture the garments (Table 3). The three-dimensional simulation results of the subjects were processed in order and represented in Table 4.

Table 3. Experimental garments

	Subject A	Subject B
ESMOD		
Bunka		
Aldrich		
Armstrong		

Table 4. Experimental three-dimensional simulated garments

	Subject A	Subject B
ESMOD		
Bunka		
Aldrich		
Armstrong		

3.2. Results of Fit Evaluation

Experts' examinations: The appearance examinations were conducted by 18 experts who have background knowledge of pattern making. The experts examined the photos of the trouser fronts, sides, and backs respectively. The results of fit examinations on real garments and three-dimensional simulated garments were evaluated (Table 5).

4. ANALYSIS AND SUGGESTION

4.1. Analysis of fit evaluation results

The photos of the front, side, and back of the subjects wearing the experimental trouser and three-dimensional simulated data were evaluated by 18 clothing-majored evaluators, using a questionnaire consisting 26 questions. It was suggested that Aldrich's method suits both Subject A and B better in real garment examination. However, there was distinct mean value difference

(12.33) between Subjects A and B and it can be inferred that the overall satisfaction of Subject A was rated higher than Subject B (Table 6).

Table 5. Results of the appearance examinations

		Real garments								three-dimensional simulated garments							
		ESMOD		Bunka		Aldrich		Armstrong		ESMOD		Bunka		Aldrich		Armstrong	
		A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
F	mean	3.18	3.08	3.47	2.96	3.70	**3.29**	**3.72**	3.12	3.78	**3.05**	3.24	2.34	**3.99**	2.59	3.64	2.86
	S.D.	0.34	0.21	0.31	0.27	0.26	0.19	0.23	0.28	0.19	0.14	0.31	0.31	0.07	0.46	0.11	0.19
S	mean	3.49	**3.46**	3.85	3.42	3.83	3.39	**3.92**	3.36	**3.78**	**3.29**	3.29	2.92	3.65	2.51	3.65	3.08
	S.D.	0.22	0.19	0.23	0.22	0.39	0.12	0.38	0.26	0.17	0.28	0.30	0.37	0.05	0.11	0.14	0.28
B	mean	3.12	**3.39**	3.62	2.78	**3.86**	3.00	3.70	**3.39**	**3.83**	**3.28**	3.22	3.16	3.79	3.21	3.74	3.19
	S.D.	0.44	0.11	0.18	0.23	0.22	0.28	0.17	0.24	0.20	0.09	0.21	0.18	0.17	0.19	0.24	0.15
O	mean	**2.94**	3.17	3.61	2.67	3.44	2.67	**3.78**	3.17	3.56	2.61	2.83	2.06	3.61	2.17	**3.78**	**2.67**

Table 6. Result of the t-test: Real garments

Real garments	Subject A						Subject B					
	N	t-value	p-value	mean	S.D.	M.D.	N	t-value	p-value	mean	S.D.	M.D.
ESMOD	18	20.62	.000	83.05	17.08	4.02	18	35.57	.000	83.77	9.99	2.35
Bunka	18	35.44	.000	93.16	11.15	2.62	18	19.95	.000	81.33	17.29	4.07
Aldrich	18	32.64	.000	**97.94**	**12.73**	**3.00**	18	20.40	.000	**85.61**	**17.8**	**4.19**
Armstrong	18	42.13	.000	97.44	9.8	2.31	18	29.23	.000	84.05	12.19	2.87

Table 7. Result of the t-test: three-dimensional simulated garments

three-dimensional simulation	Subject A						Subject B					
	N	t-value	p-value	mean	S.D.	M.D.	N	t-value	p-value	mean	S.D.	M.D.
ESMOD	18	33.27	.000	98.44	12.55	2.95	18	25.74	.000	**82.00**	**13.51**	**3.18**
Bunka	18	26.65	.000	83.50	13.28	3.13	18	20.05	.000	70.83	14.98	3.53
Aldrich	18	27.84	.000	**101.44**	**15.45**	**3.64**	18	19.66	.000	73.16	15.78	3.72
Armstrong	18	36.47	.000	96	11.16	2.63	18	26.55	.000	78.61	12.56	2.96

Overall, the results of three-dimensional simulated garment examinations indicated that Aldrich method suited Subject A better but the ESMOD's method was deemed the most appropriate for Subject B (Table 7). As a consequence of an analytical t-test conducted in SPSS, the results of this experiment are said to be statistically significant in Subject A and B due to the p-value being less than 0.001.

5. CONCLUSIONS

Through this study, the suitability data of each subject was collected resulting in feedback from the fit evaluation. Even though this study was challenging, it has possibilities for improving the appropriate fit of trousers and for developing a better understanding of body shape and size.

The evaluations determined that Aldrich method was the most suitable for both subjects in the real garment examination. However, it was suggested that Aldrich's method was better suited for the

Subject A and the ESMOD's method suited better for Subject B in the three-dimensional virtual simulated garment examination.
Through conducting the experiment and analysing the fit evaluations, the significant results were found and are described as follows.

Q1. Which method is suitable for each subject?:
As previously stated in the analysis of the fit evaluation results, it was suggested that the Aldrich method was the most suitable for Subjects A and B in the real garment examination. Furthermore, it was evaluated in the three-dimensional virtual simulated garment examination that Aldrich method better suited Subject A and the ESMOD's method better suited Subject B.

Q2. Do the results of the fit evaluation show the same satisfaction between Subjects A and B / real garments and three-dimensional simulated garments?:
Through the results from a t-test, it is shown that there is the minimum difference in the Bunka's method in the evaluation of the real garments and three-dimensional virtual simulated garments. In addition, there is a considerable difference between the real garments and the three-dimensional simulated garments in the fit evaluation's satisfaction rates (11.19 in mean difference).

During the research, there were some limitations which have influenced the overall results of the research and are listed as follows.
■ First, there are numerous variations to define clothing comfort and fit preference individually, which may be affected by ethnic group, culture, climate, age, etc. These may have affected the results in the fit evaluations. ■ Second, there were only two subjects in this research, and they were inadequate to represent prototypes of all body shapes. In addition, the number of experts who participated in the fit evaluation was also insufficient to form a generalisation. ■ Third, precise considerations about body shape were needed to develop the researcher's suggested pattern. For example, there might be distinctive difference between wide hip and protruding hip even though each subject has the same hip circumference size.
It is suggested that, when choosing and analysing subjects for comparison, significant consideration should be given to body shapes and sizes. In order to increase the reliability of the results of questionnaires, it is recommended that more participants are used in the survey. In addition, it is expected that three-dimensional virtual simulation programs can provide precise images, equivalent to real photos.

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