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CONGRESS PAPER

Relationship Between Virtual Prototype and Physical Fitting of an Apparel Developed for Fishmongers Using Computer-Aided Design In Aba Metropolis

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Abstract

The research work centered on the relationship between virtual fitting and physical fitting of an apparel developed for fishmongers using computer-aided design in Aba Metropolis. Specifically, the study was designed to test virtually the fit of an apparel developed for fishmongers using CAD; to test physically the fit of an apparel developed for fishmongers and to determine the relationship between the virtual fitting and physical fitting of an apparel developed for fishmongers using CAD. Three research questions and one hypothesis guided the study. The population for the study was thirty students and three lecturers in clothing and textile in the University of Uyo. Purpose Sampling technique was employed to select all the thirty students and three clothing and textile lecturers as judges. Their population was small and they have adequate knowledge of computer-aided design and virtual prototype. The instrument was the relationship between virtual prototype fitting and physical fitting of apparel developed for fishmongers (RVPFPF). Descriptive statistics of frequency mean and standard deviation were used to analyze the research questions while Pearson Product-Moment Correlation was used to test the hypothesis at .05 level of significance. The findings revealed that the students and the judges rated the fit of the functional apparel very good for virtual and physical fitting as their cluster mean were above 3.00 on fit of shoulder, bust, waist overall length and neckline. The cluster mean for virtual were 4.28 and 4.27 and physical fitting 3.36 and 3.16 respectively while standing and bending. There was no significant difference in the mean responses of the students and the judges on the relationship between the virtual and physical fit of the apparel. It was therefore concluded that virtual prototype fitting is essential when developing apparel using CAD before the actual physical fitting. Therefore, it is recommended among others that virtual prototyping should be used by apparel designers when developing patterns using CAD.

KEYWORDS: **VIRTUAL PROTOTYPE, PHYSICAL FITTING, APPAREL, FISHMONGERS, COMPUTER-AIDED DESIGN.**

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Introduction

Computer-aided design is the use of computer technology for the process of design and design documentation (Palak, 2015). It also involves the use of specialized programs to create designs and design components on the computer. Computer-aided design (CAD) is also known as computer-aided drafting which describes the process of drafting with a computer. CAD tools have internalized a large part of the technical skills needed, being one of the most popular tools in the process of designing new products. Computer-aided design software started with simply digitalizing 2D flat patterns for computerized cutting of piles of spread materials and graduated to software suites with design, pattern making, grading and making modules that enable the designer create, grade, mark and exchange 2D pattern data with ease (Stewart, 2008). Recently, CAD software has improved to the extent that there are tools for simulating the construction of a virtual prototype, implementing the 2D pattern data and cloth animation algorithms to construct the sample garment on a virtual 3D model. This advanced to CAD technology that has more visual apparel design and analysis, from concept to prototype.

Prototype in apparel is a rudimentary working sample, model, mock-up or a simulation of the actual product based on which the final product is developed (Aashish, 2021). Li-na, (2014) stated that prototype is the of apparel structure design, a foundation pattern after choosing a great deal of human data related to apparel structure. Khar and Ghosh (2018) defined prototyping in design process as the translation of two-dimensional drawing to three-dimensional product to check the fit and look. The main motive behind prototyping is to validate the design of the actual product. Engineering a prototype involves the creation of physical products to respond to customer needs (Aashish, 2021). It embraces sequential activities and tasks which translate customer needs into product design. Apparel design has progressed to the stage of offering 3D virtual simulations. This simulation typically requires the designer to specify 2D pattern piece locations in relation to the body like the front, back, right and left and at the same time identify and match seams that are sewn together during construction. The 2D patterns are then placed on a 3D model and a simulation of the assembly and drape results in a virtual prototype.

Virtual prototyping is using virtual reality to create product prototypes and their properties. It is also the visualization of garments and fabric drape on a 3D avatar (Hich, 2012). Virtual prototyping is a technique in the process of product development. It contains computer-aided design (CAD) and computer-aided engineering (CAE) software to validate a design before committing to making a physical prototype (Puri, 2013). It is carried out by creating (usually 3D) computer generated geometrical shapes and either combining them into an assembly or testing different automated motions. Virtual prototyping permit designers to gauge and enhance product performance virtually. 3D can reduce the prototyping cost as designers can now decide whether or not to take a product to the market. It helps to reduce the cost of rejecting a style in terms of material, labour and time (Puri, 2013). The virtual prototype is a good step towards getting an early proof of concept and achieving conceptual clarity (Hich, 2012). It helps to gather early feedback from potential customers and users Virtual prototyping has the ability to enhance sample approval process considerably with initial pattern construction and fit problems identified and corrected on the digital flat pattern before any fabric is cut. Hich (2012) spelt out some examples of virtual tools such as Bernina My Label 3D fashion pattern software, Modaris 3D Fit by Lectra, Vidya by Assyst, V-stitcher by Browzwear, PDS version 10, Tuka 3D by Tukatech, 3D CAD system staprim from Russia and Assol 3D. CAD being equipped with all these functions can be employed in testing the fit of functional apparel

to meet the needs of the persons in diversified occupations. These virtual tools are very good for avatar fit simulation. Fit simulation is a type of computer application that helps users interact with certain stimuli by projecting a realistic graphical representation often in three dimensions (Durant, 2012). Fashion CAD software helps a designer to see her creation not only as a digital image, but also create scale on pieces and denote dimension of sleeves and hems. Giselle, (2015) pointed that it help the designer to see her design on a virtual model and then play with colour and fabric choices to perfect that design. This enhances the creativity of the designer coming to play in the process of product development of functional apparel.

Functional Apparel is defined as user-requirement specific and designed or engineered to meet the performance requirement of the user under extreme conditions (Gupta, 2011). The apparel serves as a protection for the wearer from hazardous environments. In addition to the functionality aspect of apparel, all functional apparel/clothing must fulfil certain requirements which are common to all users. These requirements include physiological, Biomechanical, ergonomics and psychological considerations. This functional apparel should be in line with the social and cultural background, geographical location, age, sex, activity and work profile of the user and serves as protection for the wearer from environmental conditions as well as work or task-related conditions that expose the wearer to certain risk in operation (Barker, 2007). Fishmongers require better work clothing against environmental hazards at the same time the clothing has to meet the requirement of functional clothing which include mobility, fit, comfort, protection/safety, utilitarian, aesthetic and expressive attributes.

Fishmongers are people that prepare and sell fish products, iced or un-iced to members of the public. They have a deep understanding of the fish species, preparation methods and detailed product knowledge (Crown, 2016). In the context of this study, fishmongers are people that sell iced or frozen fish only. In Abia, fishmongers do not have appropriate functional apparel that befits their type work. Ezema et al. (2022) developed functional apparel for this group of people. It has been observed by the researcher that lack of the application of virtual simulation in the use computer-aided design in testing the fit of an apparel using an avatar has resulted to customers complaint on fit of an apparel.

In garment construction, the process of fit testing consumes time and materials are wasted thereby leading to an increase in the price of finished product. This has been so as a result of inadequate attention to virtual simulation. Virtual simulation takes care of the challenges as the designer will see how the fit will look on the avatar using the customer's measurements. Experts agree that fitting issues are the top reason that customers return purchased items. Hence the need for this study which is directed towards the relationship between virtual prototype and physical fitting of an apparel developed for fishmongers using computer-aided design in Aba Metropolis.

Objectives of the Study

The general objective of the study was the relationship between virtual prototype fitting and physical fitting of an apparel developed for fishmongers in Aba, Nigeria.

Specifically, the study:

1) determined the mean rating of lecturers on virtual fit of apparel developed for fishmongers in Aba Metropolis.
2) determined the mean rating of students on physical fit of apparel developed for fishmongers in Aba Metropolis.
3) determined the relationship in the scores of lectures and students on virtual fitting and physical fitting of apparel developed for fishmongers in Aba Metropolis.

Research Questions for the Study

The following research questions guided the study.

1) What are the mean ratings of lecturers on the virtual fit of apparel developed for fishmongers in Aba Metropolis?
2) What are the mean rating of students on the physical fit of apparel developed for fishmongers in Aba Metropolis?
3) What is the relationship in the scores of lectures and students on virtual fitting and physical fitting of apparel developed for fishmongers in Aba Metropolis?

Hypothesis

The following hypothesis guided the study.

Ho_1 There is no significant relationship in the scores of lectures and students on virtual fitting and physical fitting of apparel developed for fishmongers in Aba Metropolis.

Research Design

The research were survey and Research and Development study and employed the research and development design. Barker (2007) stated that the research and development (R&D) design uses researcher's findings to design new products and procedures, followed by application of research methods to filed-test, evaluate and refine the products and procedures until they meet specified criteria of effectiveness, quality or similar standards.

Area of the study

The study was carried out in Abia State in South –Eastern Nigeria which was created on 27th August, 1991 out of the old Imo State. It occupies a land area of about 5, 243.7 square kilometers (NGEX, 2013). It has common boundaries with Ebonyi and Enugu States to the north, River state to the south and southwest Cross River and Akwa Ibom States to the east and south east respectively.

Population for the Study

The total population for the study was thirty (30). Fifteen lecturers and fifteen students from Home Economics department.

Sample and Sampling Technique

The total population was purposively selected as the sample size since it was small and the group has adequate knowledge of fit and virtual prototype. Therefore, the sample size was thirty.

Instruments for Data Collection

The instrument for the study was a structured questionnaire labeled Functional Apparel Design Assessment Instrument for Judges (FADAJ). The mode of scoring was a five point likert scale of Excellent-5, Very Good-4, Good-3, Bad-2, Very Bad-1.

Method of Data Collection

With the help two research assistance the researcher was able to conduct the assessment section of the virtual and physical fitting. After scoring by the judges the researcher retrieved the instrument.

Virtual Fitting

The three-quarter coat was constructed by Nwonye et al (2021) using Bernina My 3D Label. The same measurements were used for both virtual and physical fit. For the virtual simulation 2D patterns were imported into Bernina My 3D Label software and the fabric for the apparel. The patterns were virtually simulated on the model.

Dressing the Model

The three quatre coat that served as a work cloth for fishmongers was displayed on the work table. The researcher selected the model and the body-sized category in the model view. To place the style or design on the model and begin the 3D simulation:

i. Click on the simulate tool in the model Tool toolbar, located above the model view window.

ii. Click the simulation button, the style will enter the mode view window. The pattern pieces were placed around the model and the simulation process started. Throughout the simulation process, a bar appeared below the model indicating the amount of the full simulation which has been completed. As the bar was in view, the model was not to rotate or move.

iii. Once the simulation bar disappeared, one may rotate or move the model in any direction.

Note: Changes may be made to the design and re-simulate the garment drape on the model.

Rotating the Model

The model in the model view can be rotated at 360 degree in any direction. Using the mouse, the researcher rotated the model in any direction or angle. The rotation was done following the steps below:

i. Left-clicking on the mouse and dragging the model to the left or to the right, the model remains at the same angle and turns in the direction the researcher was dragging

ii. Left-Clicking on the mouse and dragging the mouse up, the researcher zooms out and the model appeared further away.

iii. Left-clicking on our mouse and dragging the mouse down, the researcher zooms in and the model will appear closer.

iv. Right-clicking on the mouse and dragging the mouse down, the model rotates forward.

v. Right-clicking on the mouse and dragging the mouse down, the model rotates forward.

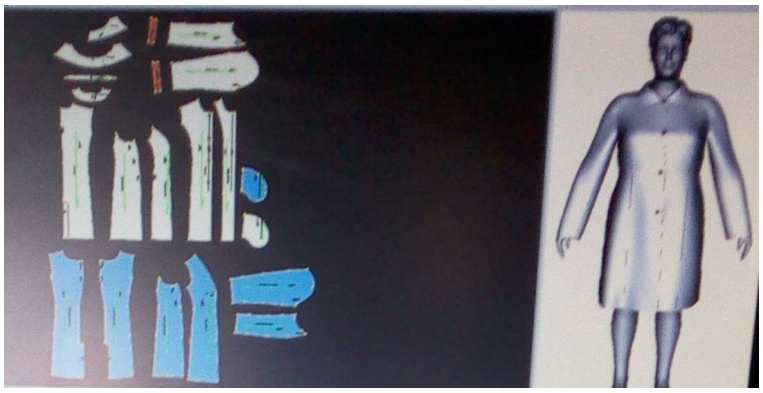
vi. Right and left clicking together allows one to change the position of the model on the screen.

vii. To create the model, push-down on the mouse wheel.

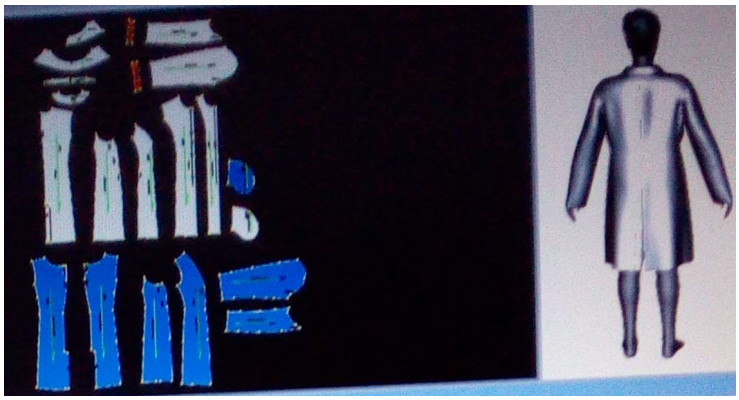
Virtual fit score by the lecturers using five-point Likert scale of excellent, very good, Good, Bad and Very Bad.

The 3-Dimensional model was dressed when the male students were ready to see what the finished product looked like on the body that reflected the sized category.

They scored on the virtual fit of the apparel on areas like tightness of neckline, Armhole area, fit of shoulder area, bust area, waist area, hip area and overall length.



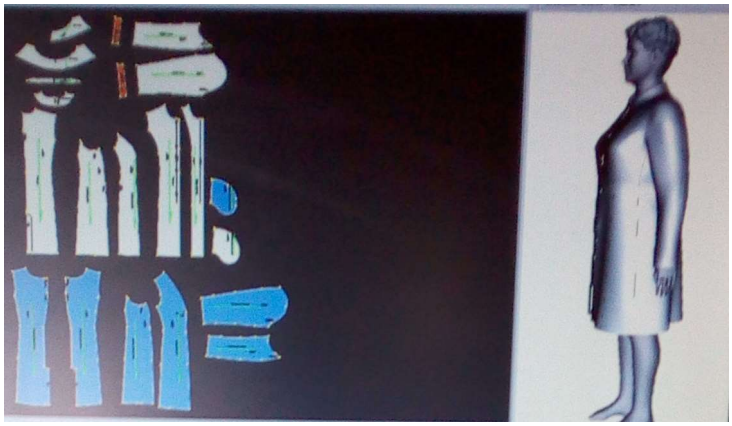
Front View of the Model



Back View of the Model

Side View of the Model

Figure 1 Pictures for physical fit



Side View of the Model

Figure 1 Pictures for physical fit (cont)

Physical fitting by Female students

The model of same sized category was dressed physically and fifteen students scored the fit of the apparel on the stated variables. After scoring, the scores of the two groups were subjected to analysis using Pearson product moment correlation to determine the relationship between the scores of the lecturers on virtual fit and students on physical fitting of the function apparel developed for fishmongers.

Method of Data Analysis

The data collected was analysed using descriptive statistics of mean, and standard deviation for the research questions and Pearson Product Moment Correlation for the hypothesis at 0.05 level of significance.

Result and Discussion

Research Question 1

What are the mean ratings of lecturers on the virtual fit of apparel developed for fishmongers in Aba Metropolis?

Table 1 Mean ratings of lecturers on virtual fit of the apparel developed n = 15

S/N	Items	Front view		Back view		Side views		Remark
		Mean	SD	Mean	SD	Mean	SD	
1	Tightness of neckline	4.17	.565	4.44	.608	4.33	.501	Good fit
2	Armhole pinching	4.17	.776	4.13	.637	4.56	.682	Good fit
3	Fit of shoulder area	4.25	.654	3.83	.776	4.61	.502	Good fit
4	Fit of bust area	4.26	.637	3.51	.652	3.99	.658	Good fit
5	Fit of waist area	4.33	.608	4.22	.716	4.20	.591	Good fit
6	Fit of hip area	4.46	.737	4.33	.722	4.01	.963	Good fit
7	Overall length	4.31	.608	4.05	.535	3.99	.651	Good fit
	Cluster mean	4.28	.660	4.72	.660	4.24	.650	**Good fit**

Table 1 shows the ratings of Lecturers on the virtual fit of functional apparel on the model when standing, the front, back and side views bending, using 5-point likert scale. The table reveals fit items which included "tightness of the neckline", "armhole pinching", "fit of shoulder area", "fit of hip area", and overall length. The responses revealed high mean rating when standing, bending and in motion for all the items in fit scale. The mean values ranged from 3.51-4.61. The cluster means of 4.28 of the lectures scores indicates good fit of functional apparel at different parts of the avatar of specific measurements that was used as the model.

Research Question 2

What are the mean ratings of students on physical fit of apparel developed for fishmongers?

Table 2 Mean ratings of students on physical fit of apparel developed n = 15

S/N	Items	Front view		Back view		Side views		Remark
		Mean	SD	Mean	SD	Mean	SD	
1	Tightness of neckline	4.06	0.91	2.99	0.88	4.54	0.59	Good fit
2	Armhole pinching	2.60	0.82	3.50	1.02	2.14	1.06	
3	Fit of shoulder area	3.40	1.06	2.77	1.03	4.61	0.54	Good fit
4	Fit of bust area	3.49	1.01	3.50	1.02	4.17	0.61	Good fit
5	Fit of waist area	3.40	1.06	3.17	0.93	3.45	1.00	Good fit
6	Fit of hip area	2.95	0.91	2.48	0.55	3.43	1.04	
7	Overall length	3.62	0.83	3.73	0.64	3.62	0.79	Good fit
	Cluster mean	3.36	0.94	3.16	0.87	0.71	0.80	Good fit

As shown in Table 2, the cluster mean ratings of the students revealed that the perception of students on the physical fit of functional apparel when the model was standing, the front, back and side views using a 5-point Likert-type scale ("5" = excellent fit and "1" = Does not fit). In the table, fit items included "tightness of neckline", armhole pinching", "fit of shoulder area", "fit of bust area", "fit of waist area", "fit hip area", and "overall length". The Mean rate of students for fit of hip when sitting area was 2.48 and armhole pinching when in motion was 2.14 indicating poor fit around these areas but the students cluster mean ratings on all items in the fit scale when subject was standing from different views was of good fit.

Research Question 3

What is the relationship between the scores of lecturers and students on virtual fit and physical fit of apparel developed for fishmongers?

Table 3 Relationship between the scores of lectures and students on virtual and physical fit of apparels developed for fishmongers

Variable	Σx Σy	Σx2 Σy2	Σxy	r	Remark
Male (x)	353	8419			Positive
			7718	0.759	
Relationship					
Female (y)	325	7117			

Data analysis in Table 3 revealed the summary of the PPMC of the relationship between the scores of lecturers and students on virtual and physical fit of apparel developed for fishmongers. The r-score of 0.76 was obtained indicating positive relationship between virtual fit and physical fit.

Hypothesis 1

Ho_1 There is no significant relationship in the scores of lectures and students on virtual fitting and physical fitting of apparel developed for fishmongers in Aba Metropolis

Table 4 Pearson's product moment correlation of relationship between lecturers and students scores on virtual and physical fit of apparel for fishmongers

Variable	Σx Σy	Σx2 Σy2	ΣΣxy	df	r-cal	r-critic	Remark
Male (x)	353	8419	7718	28	0.759	0.361	Positive
Relationship							
Female (y)	325	7117					

Data analysis in Table 4 shows that the calculated r value (0.759) was greater than the critical r value of 0.361 with the degree of freedom of 28 at 0.05 level of significance. The null hypothesis was rejected implying that there was significant relationship between the lecturers and students scores on virtual and physical fit of the apparel developed for fishmongers.

Discussion

The cluster means of 4.28 of the lectures scores indicates good fit of functional apparel at different parts of the avatar of specific measurements that was used as the model. The acceptable fit may be as a result of the computer drafting the patterns using accurate measurements that matched the avatar that was used as the model. It may also be attributed to the accurate 3D simulation by the designer using the simulation tools. To support this finding, Puri, (2013) affirmed that virtual fit ensures that the fit of a garment is as close as possible to its target customer. In line with the findings, it is also concluded that virtual dress can be used for estimating the fit and appearance of a dress before it is actually produced (Goheer, 2015; Lin & Kang, 2021; Li-na, 2014).

The findings also revealed that the cluster mean ratings of students on physical fit in all the items in the fit scale when subject was standing from different views was of good fit. This may be as a result of applying adequate steps in the sewing procedure as outlined by Bernina My 3D Label software. The result of the findings is in agreement with the statement of Armstrong (2010) and Boorady (2011) that garments hangs and fit well when appropriate procedure is applied during production. Sihong (2013) also supported the finding by pointing out that appropriate ease on various location in an apparel contribute to good fit.

There was significant relationship between the lecturers and students' scores on virtual and physical fit of the functional apparel developed for fishmongers resulting to the rejection of the null hypothesis. The significant relationship may be as a result of using same patterns for developing the apparel and using the same size of model in testing the fit.

Biographies

Prof. Priscilla Nnenna Ezema *is a professor of Home Economics with flair in Home Management and Clothing and Textiles. She is a lecturer in the Department of Agricultural and Vocational Education, Michael Okpara University of Agriculture Umudike.*
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Dr. Ngozi Ugia Nwonye has published research articles in reputable international and local journals. She has made significant contributions to research in the area of Clothing and textile by introducing the use of Computer Aided Design in developing patterns and assessing virtual fit.
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Dr. Ngozi Ugia Nwonye is a resource person in skill acquisition and has trained many youths in fashion designing, tie-dye, batik, crafts and confectionaries. She is also a professional in making functional clothing for diverse professions. Dr. Ngozi Ugia Nwonye is known for giving customized touch to Academic regalia. ***Email****: ngoziunwonye@uniuyo.edu.ng*

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