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Ergonomic Smart Mobile Phone Physical Designs based on Perceived Filipino Consumer Preference: A Structural Equation Modeling Approach

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Abstract. Today, smartphones have become necessary because of their convenience and service. Despite all its benefits and advancement, mobile phone manufacturers have not yet designed a model suitable for the Filipino population, adversely affecting the user's health and comfort. The study aims to explore and recommend an ergonomic smartphone physical design that would cater to the perceived Filipino consumer preference to improve usability and user comfort. This study uses dimensions, luminous intensity, design attractiveness, screen, material, weight, design features, grip comfort, battery life, and actual product use to examine the perceived customer preference by disseminating a self-administered questionnaire. Using multivariate data analysis and structural equation modeling (SEM), the approach will enable the researchers to evaluate relationships between the ergonomic variables on the perceived customer preference of Filipino consumers and set standards for the physical design of smartphones for Filipino users. The results of this study identified that dimensions (DI), design attractiveness (DA), design features (DF), battery life (BL), and actual product use (APU) are the variables deemed to be significant to the perceived customer preference (PCP) of Filipino consumers.

Keywords: smartphone, customer preference, smartphone design, structural equation modeling, ergonomics, usability engineering

1. Introduction

The emergence of the industry in the Philippines started during the 1990s, with telecommunication companies beginning to offer call-only services on analog networks. Fast forward to 1994, the introduction of mobile phones utilizing Global System for Mobile communications (GSM) technology developed a new form of communication, the short message service (SMS) or texting. Sanchez [1] said that as of 2019, the mobile phone penetration in the Philippines was nearly 73.97 million users. The inexpensive communication services enticed Filipinos to use mobile phones and have evolved technologically. Along with the communication services, mobile phones have taken off because of their convenience and portability compared to analog phones. The earliest mobile phones had a huge potential yet were physically small and impossible for the user interface. Their beginnings as simple and bulky phones have transformed into a multimedia platform with diverse, innovative functions to support modern life. Smartphones perform many functions. However, excessive use of such gadgets can cause different medical issues. Since Filipinos are heavily reliant on smartphones as it solves modern-day problems, the purpose of this study is to make a standard design of smartphones to conform to Filipino users.

This study aims to identify statistically significant variables affecting user satisfaction in the use of smartphones through structural equation modeling to design a user-ergonomic smartphone that will minimize the risk of injuries and enhance comfort among its end users.

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2. Methodology

2.1. Hypothesis

The paper identified several factors that can potentially negatively affect Filipinos' usage of mobile phones. This study aims to determine which of said factors has a significant effect on the overall comfort of the user.

Design features include factors such as Weight, Material, Luminous Intensity, Dimensions, Design attractiveness, and Screen size and resolution. Factors under design features play a significant role in the users' preferences. According to Chowdhury et al. and Jung et al. [2,3], perceived handiness and the dimensions and ratio of the dimensions of the components of the product are essential factors in its design, which may be associated with satisfaction of mobile phone use. According to Liu et al. [4], empirical results also justify that the aesthetic design can have a significant effect on consumer preference.

Hypothesis 1 (H1). Weight has a significant direct effect on the design features.

Hypothesis 2 (H2). Material has a significant direct effect on the design features.

Hypothesis 3 (H3). Luminous intensity, including brightness, light distribution, and warmness or coolness of the light, directly affects the design features.

Hypothesis 4 (H4). Dimensions, including height, width, thickness, and edge roundness, directly impact the design features.

Hypothesis 5 (H5). Design attractiveness, including surface texture and color, has a significant direct effect on the design features.

Hypothesis 6 (H6). Screen size and resolution have a significant direct effect on the design features.

Actual phone use includes factors such as Design features, Grip Comfort, and Battery life. In purchasing a phone, the user must consider their comfort and preferred product performance. Yi et al. [5] mentioned that it is necessary to carefully consider the effect of grip comfort on portable devices such as smartphones. Battery performance is to be studied for its impact on the user’s heat discomfort.

Hypothesis 7 (H7). Design feature use has a significant direct effect on the actual product use.

Hypothesis 8 (H8). Grip comfort has a significant direct effect on the actual product use.

Hypothesis 9 (H9). Battery life has a significant direct effect on the actual product use.

Rajasekaran et al. [6] stated that smartphones had become an integral part of people’s daily lives because of their many uses and convenience. Factors such as the actual use of the device can influence the consumer into buying the smartphone. According to Haba, Hassan, and Dastane [7], perceived usefulness, economic value, and brand image indirectly affect the intention of purchasing a smartphone. However, this will be tested in the Philippines to achieve relevant data based on the target demographics.

Hypothesis 10 (H10). Actual product use has a significant direct effect on the perceived customer preference.

2.2. Research Paradigm

From a plethora of studies regarding factors that influence user satisfaction in the use of mobile phones, this study selected factors that affect the perception of Filipino consumers when purchasing mobile phones. To approach the problem of the study, the factors are grouped into three categories: Design Features, Actual Product Use, and Perceived Customer Preference. The conceptual framework represents the relationship among the factors used in the study. Fig. 1 visualizes how the design features and the user performance influence the customer preference when purchasing mobile phones.

2.3. Questionnaire

The construct and its respective measures were presented to the respondents by utilizing questionnaires, with each main factor having four measures each and the sub-factors having two steps. With the use of the Likert scale, responses will range from (1) strongly disagree, (2) disagree, (3) neutral, (4) agree, and (5) strongly agree. Each indicator will serve as the measure for each factor, thus giving data on what factors are significant to the perceived customer preference. Data gathered from the survey questionnaires will be analyzed and used for creating the criteria for ergonomic smartphone physical designs among perceived Filipino consumer preferences.

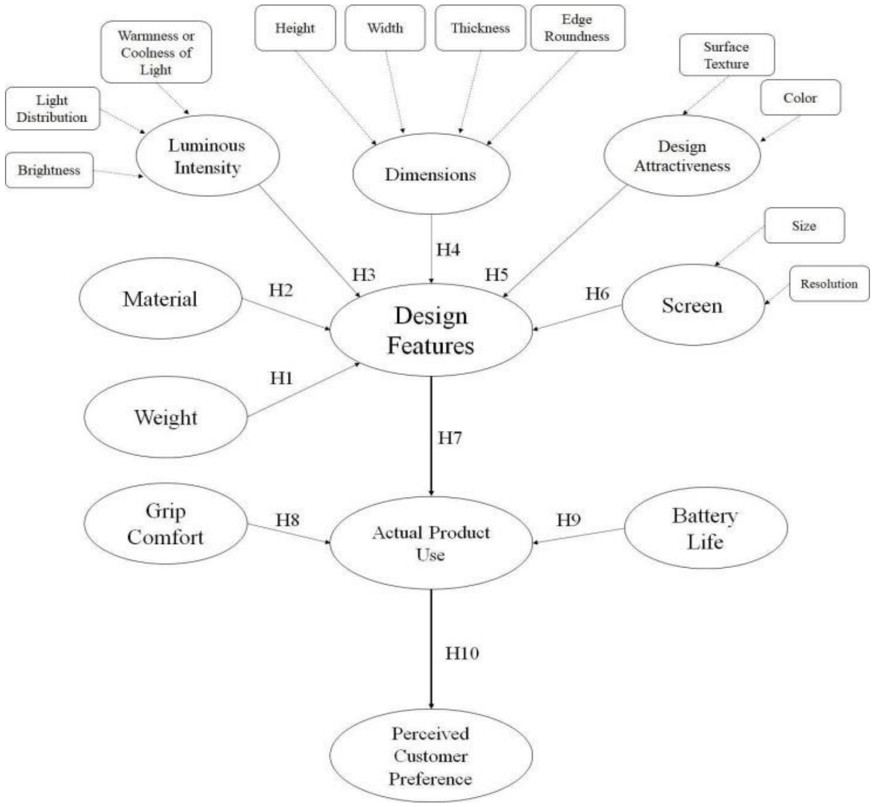

Fig. 1: Conceptual framework for the perceived customer preference.

Table 1: Constructs of the study.

Items	Questions	Supporting References
WE1	I think the weight of my smartphone is too light.	[8-10]
WE2	I think my smartphone's weight is unbearable when I place it in my pocket.	[8], [9]
WE3	I find it heavy when I use my smartphone.	[8], [9]
WE4	I find it heavy when I hold my smartphone.	[8-10]
MA1	I think it is better to have the back panel of my smartphone has have textured material.	[11]
MA2	I think it is better to have the back panel of my smartphone with a hard material.	[11]
MA3	I prefer a smartphone that is made out of durable material that can withstand pressure when dropped.	[12]
MA4	I am aware of the different materials that serve different functions.	[12]
LI1	While I use my smartphone, I experience eye aches due to brightness.	[13], [14]
LI2	While I use my smartphone, I experience eye fatigue due to brightness.	[13], [14]
LI3	I prefer the warmest light option when I use my phone during the day.	[15]
LI4	I prefer the brightest option when I use my smartphone during the day.	[16]
LI5	I prefer the brightest option when I use my smartphone during the night.	[16]
LI6	I prefer the warmest light option when I use my phone during the night.	[15]
LI7	I prefer my phone in dark mode rather than light mode.	[14]
LI8	The coolness of my phone screen color affects my mood.	[17]

DI1	I prefer having a phone with a round edge.	[8], [9]
DI2	I find it hard to fit my phone in my pocket.	[8-10]
DI3	I prefer having a bulky phone.	[8], [9], [18]
DI4	I find it easy to hold my phone with one hand.	[8], [9]
DI5	I prefer having smartphones that are thin.	[8], [9]
DI6	I think I like smartphones that are as big as my hand.	[19]
DI7	I find it easier to read on longer smartphones.	[8], [9]
DI8	I prefer having a wide phone.	[8], [9]
DA1	I think having a big smartphone screen improves usability.	[8], [9]
DA2	I prefer smartphones with buttons on the side only.	[2], [3], [20]
DA3	The color of the phone is important to me.	[2], [3], [20]
DA4	I believe that the color of the phone reflects my personality.	[21]
DA5	I prefer a smartphone with a metal-like/slick finish.	[10], [22]
DA6	Being satisfied with my smartphone's aesthetics makes me want to use it more frequently.	[23]
SC1	Having a big phone screen is causing me discomfort when using the device.	[24]
SC2	I find it comfortable to use smartphones with edge-to-edge screens.	[25]
SC3	I consider screen resolution when buying a phone.	[22]
SC4	I prefer smartphones with wider screens.	[24]
SC5	I prefer typing on a large screen.	[8], [24]
SC6	I prefer to have my phone's screen with high resolution.	[22]
DF1	I believe that physical design features are important when purchasing a product.	[2], [3]
DF2	I prefer smartphones that I can fold.	[26]
DF3	I believe that the smartphone I am using suits my personality.	[2], [3]
DF4	I believe that the smartphone I am using suits my lifestyle.	[2], [3], [20]
GC1	I prefer a smartphone that is comfortable to hold when not in use.	[8-10]
GC2	The way I hold my smartphone slows down my typing.	[27]
GC3	I think that gripping my phone with two hands is better with one hand.	[28]
GC4	I grip my phone better when it's oriented horizontally	[29]
BL1	I prefer a smartphone that has long battery life.	[30]
BL2	I prefer a smartphone that does not need to charge after a few minutes of usage.	[30]
BL3	I prefer my smartphone to have the fast-charging feature.	[31]
BL4	I prefer my smartphone to have a slim battery.	[31]
APU1	I prefer smartphones that are easy to use.	[6]
APU2	I buy smartphones based on how fast the applications run.	[6]
APU3	I prefer smartphones that have fingerprint-resistant screen coating.	[32]
APU4	I prefer smartphones with keypads that are highly sensitive to touch for less effort in typing.	[33], [34]
PCP1	I prefer smartphones that are glossy.	[4]
PCP2	I prefer smartphones with multiple camera lenses.	[35], [36]
PCP3	I prefer my smartphone to be fully touch screen.	[33], [34]

PCP4	I prefer my smartphone to be water-resistant.	[6], [33]
PCP5	I prefer my smartphone to have a sensitive screen for easy navigation.	[33]
PCP6	I prefer my smartphone to have a keypad.	[33]
PCP7	The camera placement on my phone is important to me.	[35], [36]
PCP8	I think I want to have a smartphone that is durable.	[37]

2.4. Structural Equation Modeling

Structural equation modeling (SEM) is a multivariate statistical technique for understanding and analyzing the links and interactions between constructs and variables in a system [38,39]. Specifically, Covariance-based structural equation modeling will be used since the study requires analyzing the inter-relationships among multiple factors [40]. Data gathered through these methods will then be used to create a criterion for the optimal ergonomic design of smartphones for Filipinos. This study utilized SPSS AMOS 22 to gather the results using the Maximum Likelihood estimation approach.

The model fit was evaluated using Incremental Fit Index (IFI), Tucker Lewis Index (TLI), and Comparative Fit Index (CFI) for incremental fit measures. The minimum cutoff is a value greater than 0.8 [41,42]. Using the Adjusted Goodness of Fit Index (AGFI), Root Mean Square Error of Approximation for absolute fit measurements (RMSEA), and Goodness of Fit Index (GFI), the model fit was assessed.

3. Results

3.1. Participants

A total of seven hundred thirty-nine (739) individuals voluntarily answered the survey questionnaire. All participants were Filipinos collected via convenience sampling method. Table I shows the descriptive statistics of the essential characteristics of the participants in this study. Based on the demographics, most of the respondents aged between 18 to 24 years old (64.3%), followed by 25-34 years old, 35-44 years old, 17-year-old or lower, 55-64 years old, 45-54 years old, and 65 years old and above with the percentage of 16.24%, 5.41%, 5.28%, 4.47%, 4.06%, and 0.27% respectively. For the tasks most used for smartphones, the top 3 are scrolling through social media (87.55%), streaming videos (49.93%), and taking pictures (49.12%). Lastly, results show that 27.88% of the respondents spend more than ten hours using smartphones daily, followed by 13.80% of the respondents spend five hours using smartphones daily, and 13.26% of the respondents spend eight hours using smartphones daily.

Table 2: Descriptive statistics of the respondents.

Characteristics	Category	N	%
Age Bracket	17 or lower	39	5.28
	18 - 24	475	64.28
	25 - 34	120	16.24
	35 - 44	40	5.41
	45 - 54	30	4.06
	55 - 64	33	4.47
	65 and above	2	0.27
Tasks mostly used for smartphones	Texting	345	46.68
	Email	307	41.54
	Phone Call	342	46.28
	Scrolling through social media (Facebook, Instagram, Tiktok, etc.)	647	87.55
	Streaming videos (Movies, TV shows, anime, etc.)	369	49.93

	Listening to Music	348	47.09
	Online Gaming	207	28.01
	Online Shopping	291	39.38
	Taking Pictures	363	49.12
	Online Banking	233	31.53
	Tracking Lifestyle (Workout apps, Medicine intake reminders, habit tracker, etc.)	123	16.64
	Work Productivity (Taking notes, planner apps, task management apps, etc.)	227	30.72
Number of hours spent using smartphones daily	1	14	1.89
	2	28	3.79
	3	38	5.14
	4	62	8.39
	5	102	13.8
	6	67	9.07
	7	53	7.17
	8	98	13.26
	9	22	2.98
	10	49	6.63
	10+	206	27.88

3.2. Initial SEM

Initially, the researchers considered several hypotheses in the study. Figure 2 presents the initial SEM model showing the perceived Filipino consumer preference on ergonomic, smart mobile phone designs. As the research hypotheses were tested by structural equation modeling, several hypotheses were determined to be insignificant: Weight to Design Feature (Hypothesis 1), Material to Design Feature (Hypothesis 2), Luminous Intensity to Design Feature (Hypothesis 3), Screen to Design feature (Hypothesis 6), and Grip comfort to Actual Product Use (Hypothesis 8). Thus, the researchers made changes to create a final SEM model for all the significant hypotheses.

A value greater than 0.5 is considered acceptable in accessing the factor loading value, while factor loading values of 0.30 to 0.40 are minimally adequate. To consider a lower factor loading value requires a large sample size or many variables evaluated to be considered significant [43]. Thus, a factor loading value of 0.4 is vital for this study.

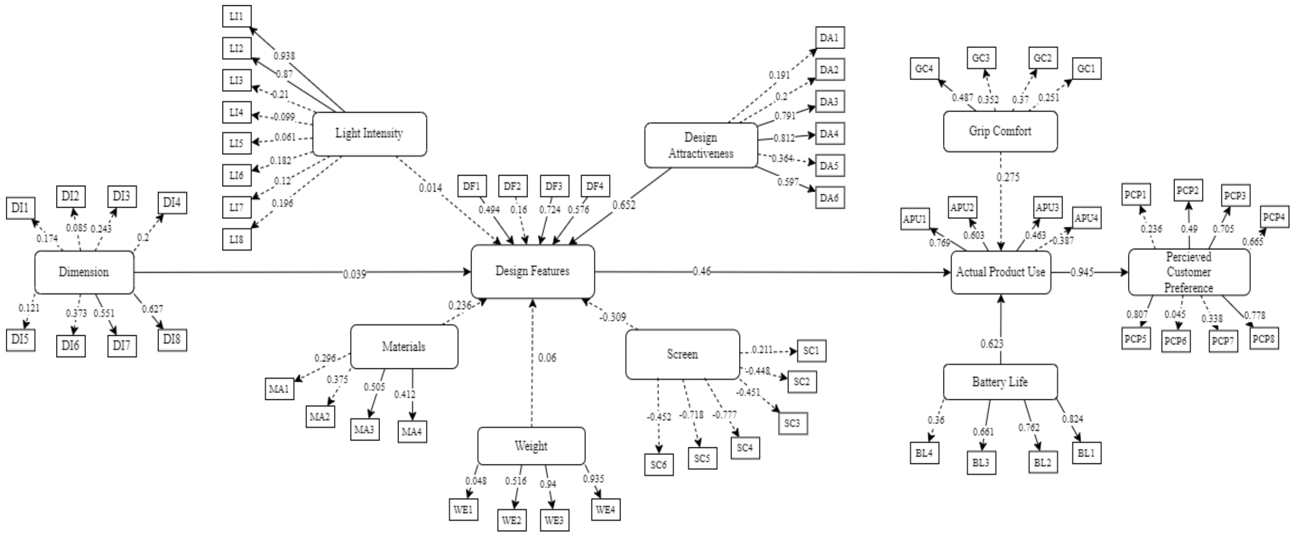

Fig. 2: Initial SEM Model

Table 3: Descriptive statistics results.

Variable	Item	Mean	Std Dev	Variance	Factor Loading	
					Initial	Final
Weight	WE1	3.15	1.022	1.045	0.048	-
	WE2	2.6	1.226	1.502	0.516	-
	WE3	2.33	1.14	1.299	0.94	-
	WE4	2.34	1.144	1.308	0.935	-
Material	MA1	3.23	1.232	1.517	0.296	-
	MA2	3.82	1.067	1.14	0.375	-
	MA3	4.73	0.598	0.358	0.505	-
	MA4	3.96	1.12	1.254	0.412	-
Luminous Intensity	LI1	3.35	1.257	1.581	0.938	-
	LI2	3.42	1.249	1.56	0.87	-
	LI3	3.43	1.276	1.628	0.21	-
	LI4	2.85	1.307	1.709	0.099	-
	LI5	1.88	1.156	1.336	0.061	-
	LI6	3.79	1.19	1.415	0.182	-
	LI7	3.77	1.421	2.02	0.12	-
	LI8	3.29	1.284	1.649	0.196	-
Dimensions	DI1	4.18	0.989	0.979	0.174	-
	DI2	3.04	1.346	1.813	0.085	-
	DI3	1.84	1.006	1.011	0.243	-
	DI4	3.95	1.098	1.206	0.2	-
	DI5	4.07	0.939	0.882	0.121	-
	DI6	3.52	1.201	1.442	0.373	-
	DI7	3.69	1.061	1.126	0.551	0.745
	DI8	3.33	1.155	1.334	0.627	0.689
Design Attractiveness	DA1	3.95	0.984	0.968	0.191	-
	DA2	3.86	1.105	1.221	0.2	-

	DA3	3.76	1.189	1.414	0.791	0.805
	DA4	3.61	1.311	1.719	0.812	0.818
	DA5	3.93	0.962	0.925	0.364	-
	DA6	4.01	1.059	1.12	0.597	0.574
Screen	SC1	2.66	1.125	1.266	0.211	-
	SC2	3.67	1.126	1.267	-0.448	-
	SC3	4.21	0.92	0.846	-0.451	-
	SC4	3.86	1.001	1.003	-0.777	-
	SC5	3.81	1.022	1.045	-0.718	-
	SC6	4.39	0.798	0.637	-0.452	-
Design Feature	DF1	4.33	0.81	0.656	0.494	0.463
	DF2	2.26	1.24	1.539	0.16	-
	DF3	3.85	1.119	1.252	0.724	0.799
	DF4	4.17	0.982	0.965	0.576	0.623
Grip Comfort	GC1	4.46	0.712	0.506	0.251	-
	GC2	3.09	1.291	1.668	0.37	-
	GC3	3.46	1.323	1.75	0.352	-
	GC4	3.01	1.329	1.767	0.487	-
Battery Life	BL1	4.89	0.379	0.144	0.824	0.847
	BL2	4.85	0.46	0.212	0.762	0.764
	BL3	4.8	0.559	0.312	0.661	0.638
	BL4	4.45	0.907	0.822	0.36	-
Actual Product Use	APU1	4.77	0.531	0.282	0.769	0.769
	APU2	4.49	0.755	0.57	0.603	0.710
	APU3	4.26	0.94	0.883	0.463	-
	APU4	3.74	1.151	1.324	0.387	-
Perceived Customer Preference	PCP1	3.39	1.112	1.237	0.236	-
	PCP2	4.05	0.955	0.912	0.49	-
	PCP3	4.36	0.902	0.813	0.705	0.707
	PCP4	4.72	0.595	0.355	0.665	0.661
	PCP5	4.17	0.914	0.836	0.807	0.802
	PCP6	2.37	1.309	1.714	0.045	-
	PCP7	3.94	1.146	1.314	0.338	-
	PCP8	4.82	0.503	0.253	0.778	0.771

3.3. Final SEM

As shown in Figure 3, the researchers did modifications on the indices to improve the model fit, and this is because the model fit results did not reach the suggested cut-off value. After the necessary changes were done, the values of the Incremental Fit Index (0.863), Tucker Lewis Index (0.812), Comparative Fit Index (0.832), Goodness of Index (0.885), and Adjusted Goodness of Fit Index (0.830) are all above the suggested cut-off of 0.80 considered to be an absolute fit [41,42]. The Root Mean Square Error of the model's approximate parameter estimate is 0.069, less than the specified minimum threshold, indicating an absolute fit [42,44]. All the parameter estimates are greater than the cut-off value. Thus, the model suggests absolute fitness and exhibits reliable and valid results.

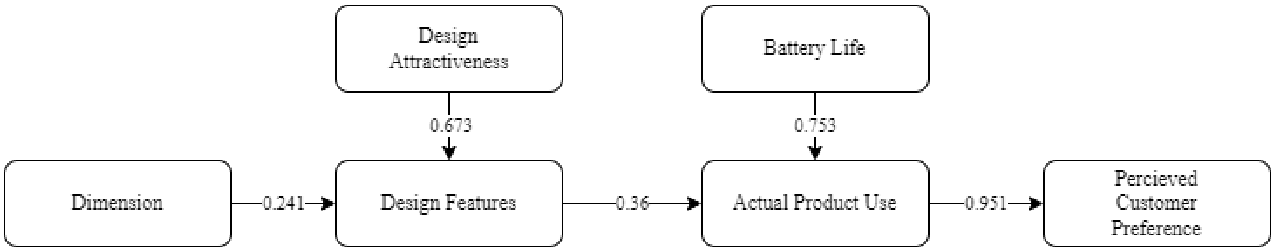

Fig. 3: Final SEM Model

Table 4: Model fit indices.

Goodness of Fit Measures	Parameter Estimates	Minimum Cutoff	Suggested by
Incremental Fit Index (IFI)	0.863	> 0.80	[41,42]
Tucker Lewis Index (TLI)	0.812	> 0.80	[41,42]
Comparative Fit Index (CFI)	0.832	> 0.80	[41,42]
Goodness of Fit Index (GFI)	0.885	> 0.80	[41,42]
Adjusted Goodness of Fit Index (AGFI)	0.830	> 0.80	[41,42]
Root Mean Square Error of Approximation (RMSEA)	0.069	< 0.07	[42,44]

In testing the survey result's reliability, the researcher utilizes Cronbach's alpha to measure internal consistency among variables, that is, how closely related a set of items are as a group. This study finds values from 0.50 to 0.70 with moderate reliability and 0.70 to 0.90 with high reliability [45]. Factors such as dimensions, design features, actual product use, and perceived customer preference show moderate reliability, while design attractiveness and battery life show high reliability.

Table 5: Composite reliability.

Factor	Constructs	Cronbach's Alpha	AVE	Composite Reliability
Dimensions	DI7 DI8	0.734	0.515	0.704
Design Attractiveness	DA3 DA4 DA6	0.769	0.549	0.781
Design Features	DF1 DF3 DF4	0.749	0.414	0.749
Battery Life	BL1 BL2 BL3	0.769	0.569	0.797
Actual Product Use	APU1 APU2	0.733	0.548	0.755
Perceived Customer Preference	PCP3 PCP4	0.777	0.544	0.753

	PCP5 PCP8			

The table below shows the indicators' direct, indirect, and total effects. There were no indicators that showed both direct and indirect effects.

Table 6: Model fit indices.

Number	Variable	Direct Effect	p-value	Indirect Effect	p-value	Total Effects	p-value
1	BL → APU	0.753	0.002	-	-	0.753	0.002
2	BL → PCP	-	-	0.716	0.001	0.716	0.001
3	DA → DF	0.673	0.003	-	-	0.673	0.003
4	DA → APU	-	-	0.243	0.001	0.243	0.001
5	DA → PCP	-	-	0.231	0.001	0.231	0.001
6	DI → DF	0.241	0.002	-	-	0.241	0.002
7	DI → APU	-	-	0.087	0.001	0.087	0.001
8	DI → PCP	-	-	0.083	0.001	0.083	0.001
9	DF →APU	0.36	0.001	-	-	0.36	0.001
10	DF → PCP	-	-	0.342	0.001	0.342	0.001
11	APU → PCP	0.951	0.003	-	-	0.951	0.003

4. Discussion

As the emergence of smart mobile phones became integrated into daily life, most Filipino consumers preferred physical phone specifications to increase usability and user comfort [10]. This study utilizes the Structural Equation Modeling (SEM) to determine which hypotheses have a significant direct effect on the Perceived customer preference. The study creates valuable data on the root causes of emerging physical and technical problems of non-ergonomic smart mobile phones and proposes solutions to decrease Filipino smartphone user discomfort.

After evaluating relationships between identified ergonomic variables, results indicated that Actual product use is a significant variable to Perceived customer preference (β: 0.951; p = 0.003). This reveals that Filipino smartphone users consider gadgets' usability and ease of use before purchasing [43]. Second, Battery life was also determined to have a significant direct effect on the Actual product use (β: 0.753, p = 0.002). A longer battery life boosts a phone's perceived usability and user experience. It is considered one of the essential factors in purchasing a smartphone since phones do not require charging after a few minutes of use [6,14]. Third, Design attractiveness has direct significant effect on Design feature (β: 0.673; p = 0.003). This indicates that Filipino consumers consider the color and surface texture of the physical design features when purchasing mobile phones since it can stimulate their emotional demands and personality [6, 21, 23,45].

Additionally, the surface texture and aesthetic design are relevant factors affecting the sensory perception of people [4,18,46]. Fourth, Design features have a significant direct effect on the Actual product use (β: 0.36; p = 0.001), indicating that smartphone users perceive physical design features as necessary [2]. As aforementioned, Filipinos believe that the devices must suit their personalities, aesthetics, lifestyle [20, 47]. Lastly, Dimensions are known to significantly affect the Design feature (β: 0.241; p = 0.002) revealing that height and width are considered important physical design features of phones [8,9]. The final SEM model indicates that Filipino smartphone users find smartphones elongated height reader-friendly because of their longer read display [8].

Surprisingly, SEM revealed several variables that were insignificant to the study, thus removing them from the model. First, the latent variable Grip comfort shows no significant effect on the Actual product use (β: 0.275; $p = 0.001$). Although Filipino consumers prefer having longer and wider phones, there are existing phone accessories that improve user usability and allow them to hold their phones with one or both hands comfortably. Second, Material does not significantly affect Design features (β: 0.236; $p = 0.004$) since most users consider using phone cases not only for aesthetic purposes but also for overall protection against scratches and sudden impacts. Third, Weight has no significant effect on Design features (β: 0.06; $p = 0.119$) since the average smartphone weighs 112 grams and it is deemed to be tolerable when handling and using it considering that the less than the maximum ideal weight for handheld tools is 400 grams [47]. Fourth, Luminous intensity has no significant effect on Design features (β: 0.014; $p = 0.698$) since the brightness and contrast of the phone can be adjusted to match the light of the surroundings, hence lessening the possibilities of eyestrain, eye aches, fatigue, and dryness [13,16].

Moreover, users may not consider luminous intensity as a factor in choosing a smartphone since most smartphones today offer the ability to adjust brightness settings up to a nit peak of 600 nits [14]. Lastly, Screen has no significant effect on Design features (β: -0.309; $p = 0.005$) since higher screen resolution does not guarantee a better user experience. Moreover, screen size does not affect the reading performance or eye comfort of the user, as consumers can adjust the font size on their smartphones which results in less visual fatigue [22,49].

5. Conclusion

Despite its various benefits, prolonged usage of this gadget is known to have adverse effects on its users [48]. Although previous studies on ergonomic smartphone designs exist, there is still limited research on addressing these smartphone user discomfort issues among Filipinos. The study's outcome indicates that the Actual Product Use, which encompasses Battery Life, is essential for Filipinos when buying smartphones. Long battery life and fast charging features are preferable in smart mobile phone designs and fast processing speed [6,14]. Design Attractiveness and dimensions are both found to have significant effects. Filipino users consider the aesthetics, length, and width of the device when evaluating their preference in the design features of smartphones. More comprehensive and more extended devices are preferable since they result in better productivity and more extended read display, contributing to ease of use [8]. Design Attractiveness also plays a role in the preference of smartphone users since color and surface texture are factors that affect consumer purchase behavior [6,20].

The insignificance of Grip Comfort means the orientation the user is gripping the device does not contribute to the usability of the smartphone. Material, Weight, Light intensity, and Screen do not relate with Design features. The study shows that Filipino users do not perceive the durability and functions of different materials used for the smartphones' back panels to be significant in the device's design features. Results show that consumers do not consider weight in buying a smartphone. Based on the results, eye aches and fatigue are not effects of the phone's screen's brightness. The smartphone screen’s design, size, and resolution are insignificant in the smart mobile phone's design features. Several variables identified to be significant in this study are related to improving the comfort in the use of smartphones, which results in decreased health risks, such as Text Neck Syndrome, De Quervain’s Syndrome, and Visual Impairments [16].

The study pioneers the assessment of smartphones' key ergonomic physical design that identifies which factors are significant in usability and perceived consumer preference of Filipinos. The results found through structural equation modeling (SEM) provide new information on smartphone ergonomics among Filipino users, eliminating discomfort in using the device. Health risks associated with prolonged use of smart mobile phones may be avoided using the data on dimensions found in the study. The research also helps in satisfying Filipino consumer demand by considering significant variables such as dimensions, design attractiveness, design features, battery life, and actual product use in smartphone product design.

Furthermore, the results give fresh information and guide creating standards in physical smartphone designs. This suggests the best possible smartphone for consumers in the current market that lets manufacturers innovate on phone specifications.

This study focuses on the ergonomic features of a smartphone, thus limiting the factors to be considered. Other factors such as price, brand, storage capacity, camera, and smartphone speakers will enable future research to determine significance to the Filipino consumer. The data collected from this study were based on the preferences and opinions of Filipino consumers on smartphones. Thus, to further improve upon this study, the researchers recommend gathering actual dimensions like height, width, and thickness of the phone, the preferred color, and the capacity of the smartphone's battery.

6. References

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