



**15TH NATIONAL
CONVENTION
ON STATISTICS**

03-05 OCTOBER 2022

*Organized by the Philippine Statistical System
Spearheaded by the Philippine Statistics Authority*



Models of Behavioral Intention and Usage Behavior Towards Digital Healthcare Platform

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Statistical Methods in Genetics and Bioinformatics

Crowne Plaza Manila Galleria

October 4, 2022, 8:30 – 10:00 AM



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MOTIVATION

CNN BUSINESS

• PERSPECTIVES •

Hospitals were struggling before the pandemic. Now they face financial disaster

By David Shulkin for CNN Business Perspectives
Updated 1212 GMT (2012 HKT) April 22, 2020

BBC NEWS FOLLOW

Cancer surgery: Thousands of 'red flag' cancer procedures cancelled

BY NIALL MCCracken
3 FEBRUARY 2021 • 3-MIN READ

BBC NEWS FOLLOW

Covid: 3,500 'missing' from cancer services in Wales

3 FEBRUARY 2021 • 3-MIN READ



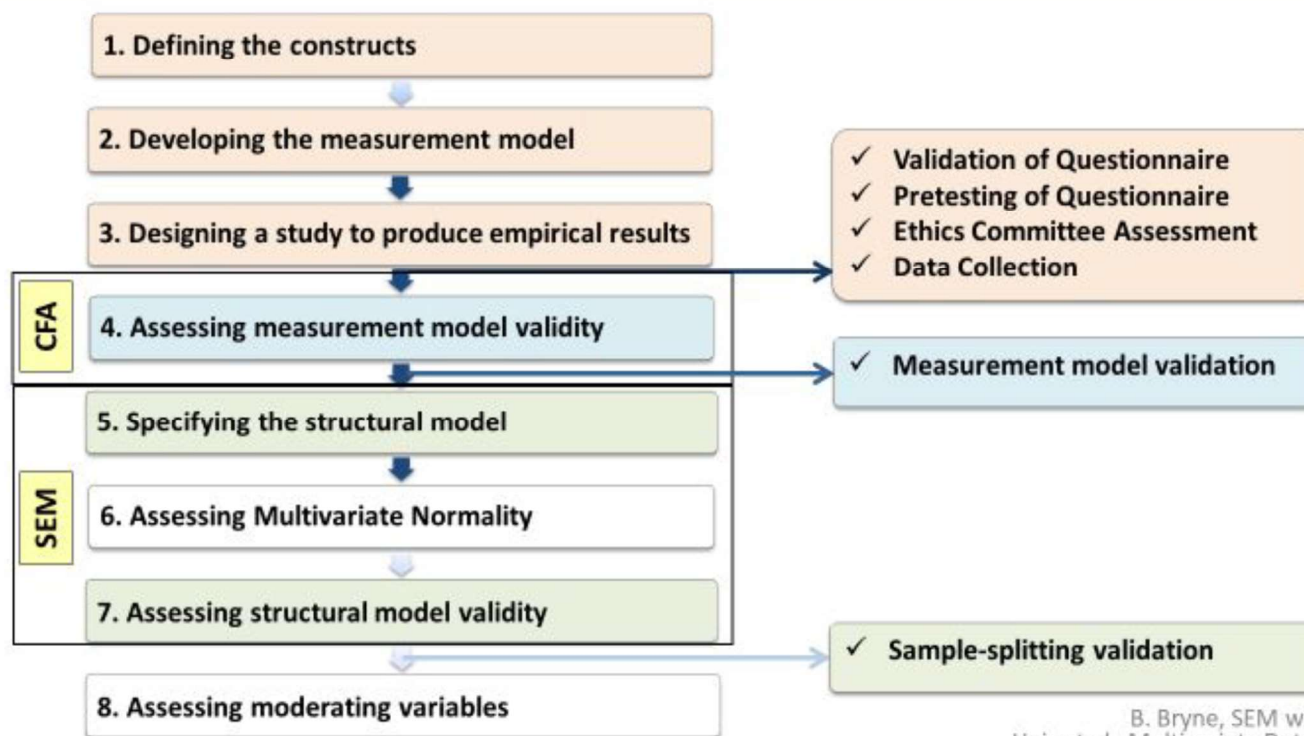
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STATISTICAL TREATMENT



B. Bryne, SEM with AMOS, 2010
Hair *et al.*, Multivariate Data Analysis, 2014
Awang, Z, A Handbook of SEM using AMOS, 2012



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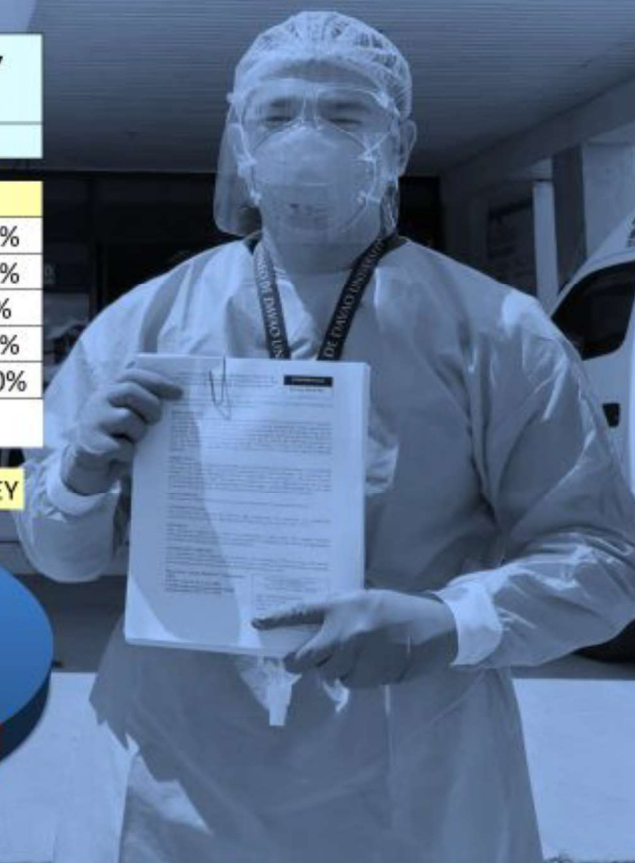
DATA COLLECTION SUMMARY

Period: November 15, 2020 – February 15, 2021

TRADITIONAL SURVEY			ONLINE SURVEY		
VALID	351	64%	VALID	187	38%
INVALID	83	15%	INVALID	111	22%
PRETEST SAMPLE	33	6%	PRETEST SAMPLE	17	3%
UNRETURNED	83	15%	UNRETURNED EMAIL	180	36%
TOTAL SURVEY	550	100%	TOTAL SURVEY	495	100%
*Total returned is 467			*Total returned is 315		

TOTAL COMBINED (TRADITIONAL & ONLINE)		
VALID	538	51%
INVALID	194	19%
PRETEST SAMPLE	50	5%
UNRETURNED	263	25%
TOTAL SURVEY ACCESSIBLE	1045	100%
*Total returned survey is 782		

DISTRIBUTION OF SURVEY





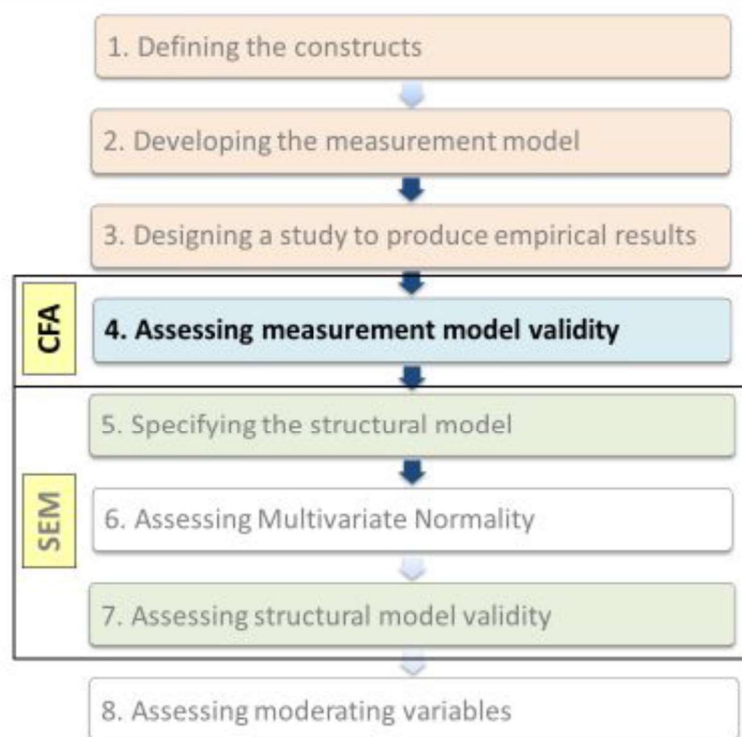
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I. CONFIRMATORY FACTOR ANALYSIS



SUMMARY:

- The proposed UTAUT model has better model fit in the local context compared to the original UTAUT model.
- Trust and Information Quality were found to be also applicable in the local context.
- Five new measured scales were originally prepared and have been validated for this study (TR5, IQ, IQ5, UB4, and UB5).
- After 8 model respecifications, a total of 39 measurement scales were observed to relate significantly for the constructs of the proposed model.

B. Bryne, SEM with AMOS, 2010
Hair et al., Multivariate Data Analysis, 2014



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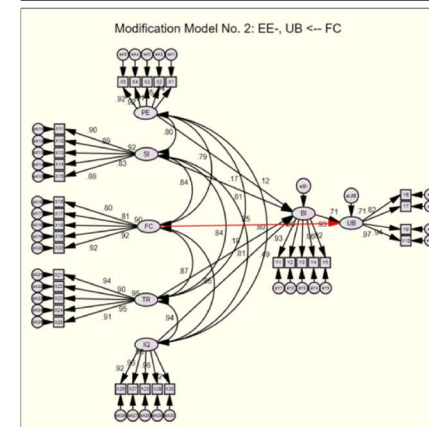
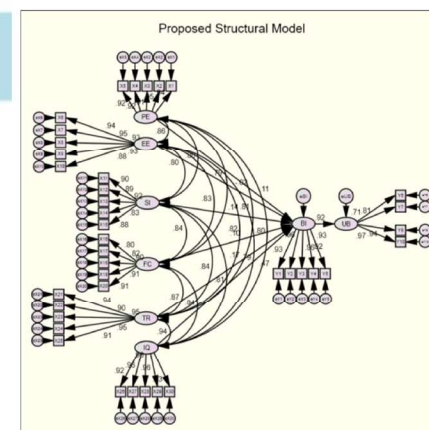
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STRUCTURAL MODEL

Goodness of fit (N = 538, m = 39)	Criteria	Proposed UTAUT	MOD4	MOD2	Interpretation
		BI <-- EE, BI <- FC	BI <-- EE, UB <-- FC	EE-, UB <-- FC	
I. Absolute Fit					
χ^2 statistic	Close to zero	$\chi^2 = 3066$, DF = 680, $p = 0.000$	$\chi^2 = 3029$, DF = 680, $p = 0.000$	$\chi^2 = 2497$, DF = 511, $p = 0.000$	Acceptable
RMSEA	≤ 0.10	0.081	0.080	0.085	Marginal fit
SRMR	≤ 0.08	0.040	0.034	0.036	Acceptable
Normed χ^2	≤ 5.0	4.508	4.455	4.886	Acceptable
II. Incremental Fit					
CFI	≥ 0.9	0.928	0.929	0.930	Acceptable
III. Parsimony Fit Index					
PNFI	≥ 0.5	0.834	0.8350	0.8320	Acceptable





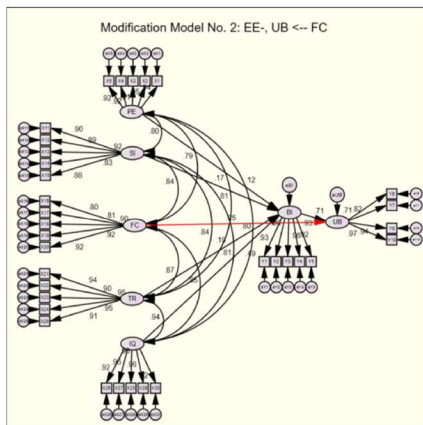
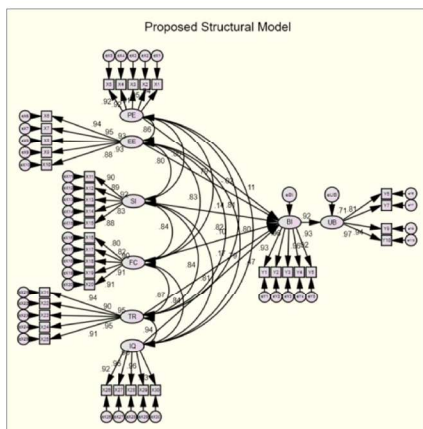
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STRUCTURAL MODEL



Relationship	Proposed UTAUT	MOD4	MOD2	Interpretation
	BI <- EE, BI <- FC	BI <- EE, UB <- FC	EE-, UB <- FC	
	Estimate, <i>p</i> -value	Estimate, <i>p</i> -value	Estimate, <i>p</i> -value	
BI <- SI	0.150, <i>p</i> = 0.001	0.178, <i>p</i> = 0.000	0.179, <i>p</i> = 0.000	SI positively relates to BI, statistically significant.
BI <- FC	0.100, <i>p</i> = 0.058	NA	NA	BI <- FC is statistically insignificant.
BI <- TR	0.179, <i>p</i> = 0.023	0.201, <i>p</i> = 0.011	0.204, <i>p</i> = 0.008	TR positively relates to BI, statistically significant.
BI <- IQ	0.482, <i>p</i> = 0.000	0.505, <i>p</i> = 0.000	0.504, <i>p</i> = 0.000	IQ positively relates to BI, statistically significant.
BI <- EE	-0.017, <i>p</i> = 0.774	0.007, <i>p</i> = 0.884	NA	BI <- EE is statistically insignificant.
BI <- PE	0.119, <i>p</i> = 0.012	0.116, <i>p</i> = 0.016	0.116, <i>p</i> = 0.002	PE positively relates to BI, statistically significant.
UB <- BI	0.768, <i>p</i> = 0.000	0.601, <i>p</i> = 0.000	0.601, <i>p</i> = 0.000	BI positively relates to UB, statistically significant.
UB <- FC	NA	0.216, <i>p</i> = 0.000	0.214, <i>p</i> = 0.000	FC positively relates to UB, statistically significant.

Analysis:

- MOD4 has the best model fit based on GOF parameters.
- However, the initial estimates of MOD4 suggests the removal of relationships BI <- EE and BI <- FC, which is basically MOD2 (EE-, UB <- FC).
- Considering this the proposed UTAUT model and MOD2 will be further subjected for multivariate normality assessment to validate the significance of the construct relationship.



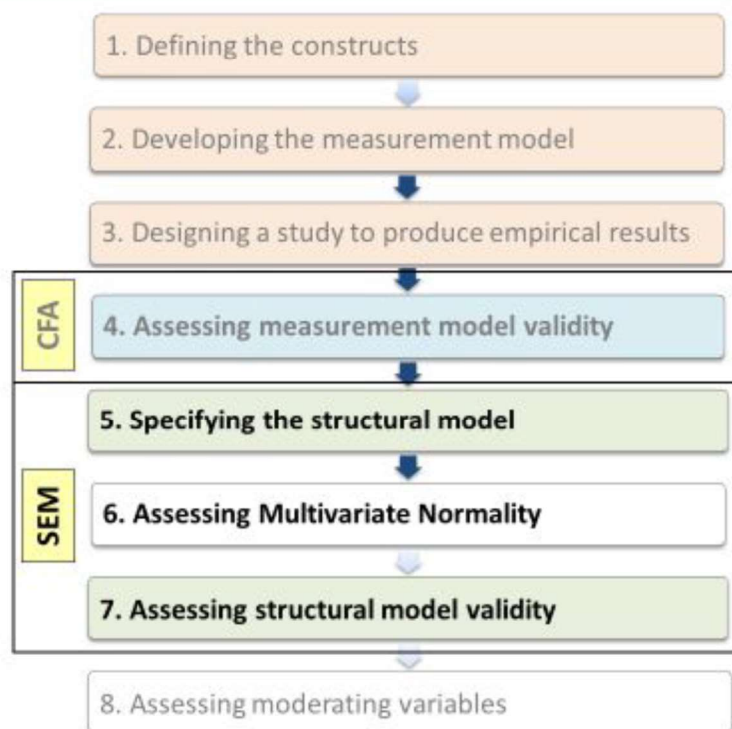
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II. STRUCTURAL EQUATION MODELING



SUMMARY:

- Structural model was specified, then followed by a series of model modification based on grounded theory.
- Two models have been assessed for multivariate normality using bootstrapping in AMOS.
- The proposed UTAUT model implied that constructs EE, FC, and TR are not statistically significant.
- MOD2 was created to further test the model, where FC has been treated as direct determinant of UB. For this model, only EE and TR were found to be insignificant.
- Using the respecified measured scales of the proposed UTAUT model, two models have been formulated that satisfy the GOF parameters set for the study. All indicators have been excellently achieved except for RMSEA which indicates a marginal fit for both models.

Hair et al., Multivariate Data Analysis, 2014 ; B. Bryne, SEM with AMOS, 2010



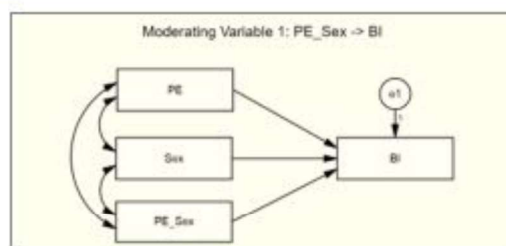
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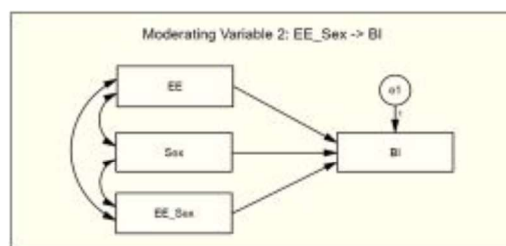


III. MODERATING VARIABLE: SEX



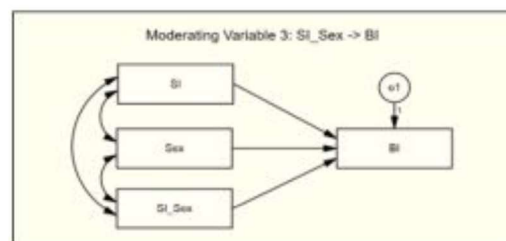
Performance Expectancy	Estimate	SE	CR	<i>p</i>	Interpretation
BI ← PE	0.984	0.099	9.893	***	Significant
BI ← Sex	0.316	0.204	1.555	0.12	Not Significant
BI ← PE_Sex	-0.124	0.059	-2.113	0.035	Significant

Analysis: Sex negatively associate and partially moderates the effect of BI ← PE.



Effort Expectancy	Estimate	SE	CR	<i>p</i>	Interpretation
BI ← EE	0.941	0.103	9.174	***	Significant
BI ← Sex	0.275	0.212	1.293	0.196	Not Significant
BI ← EE_Sex	-0.117	0.061	-1.907	0.057	Not Significant

Analysis: Sex does not moderate the effect of BI ← EE.



Social Influence	Estimate	SE	CR	<i>p</i>	Interpretation
BI ← SI	1.034	0.107	9.644	***	Significant
BI ← Sex	0.336	0.224	1.497	0.134	Not Significant
BI ← SI_Sex	-0.129	0.062	-2.073	0.038	Significant

Analysis: Sex negatively associate and partially moderates the effect of BI ← SI.

Awang, Z, A Handbook of SEM using AMOS, 2012



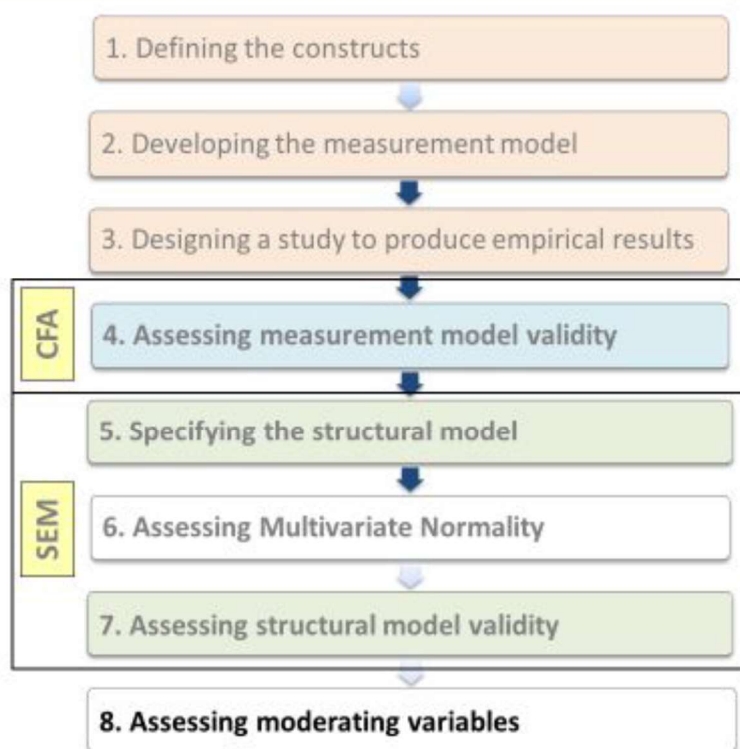
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III. MODERATING VARIABLES



SUMMARY:

- The latent constructs were treated as observed variables to allow the assessment of moderating variables.
- AMOS analysis has been performed for each moderating variable-to-construct relationships.
- Sex partially moderates the effect for $BI \leftarrow PE$ and $BI \leftarrow SI$ paths.
- MGA is recommended to be used in the future to further validate the effect of the identified moderating variables (sex, age, and end-user classification) in the local context.

Awang, Z, A Handbook of SEM using AMOS, 2012
Hair *et al.*, Multivariate Data Analysis, 2014
B. Bryne, SEM with AMOS, 2010



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IV. IMPLICATIONS

Dimensions	Implications
<ul style="list-style-type: none"> Theoretical Front 	<ul style="list-style-type: none"> ✓ The study expands that generalizability and acceptability of the UTAUT. ✓ Trust and Information Quality are acceptable in Davao Region (CFA), however only Information Quality has been established to be statistically significant using SEM in the healthcare industry. ✓ The original 6 constructs of UTAUT were also acceptable in Davao Region (CFA), but only PE, SE, FC, BI, and UB were found to be applicable in the healthcare industry. ✓ 5 new measured scales have been contributed for future use (TR5, IQ4, IQ5, UB4, and UB5). ✓ Two models can be used to further assess the BI and UB in Davao Region.
<ul style="list-style-type: none"> Healthcare Industry 	<ul style="list-style-type: none"> ✓ Factors that will help in cultivating a culture of embracing digital transformation in healthcare were identified. ✓ The said factor together with targeted strategies can help convert regular outpatients to e-patients. ✓ Understanding the factors that affect BI and UB will allow hospital management to design DHCP that would effectively engage their patients.
<ul style="list-style-type: none"> Policymaker 	<ul style="list-style-type: none"> ✓ The result of the study supports the 2016 WHO recommendation for a comprehensive legal framework for digital healthcare (<i>e-Health</i> and <i>m-Health</i>), and monitoring and implementation of current projects related to DHCP.
<ul style="list-style-type: none"> Research 	<ul style="list-style-type: none"> ✓ The establishment of UTAUT's applicability in the local context opens the door for future researcher to use the model not only in healthcare industry but in other industry as well.



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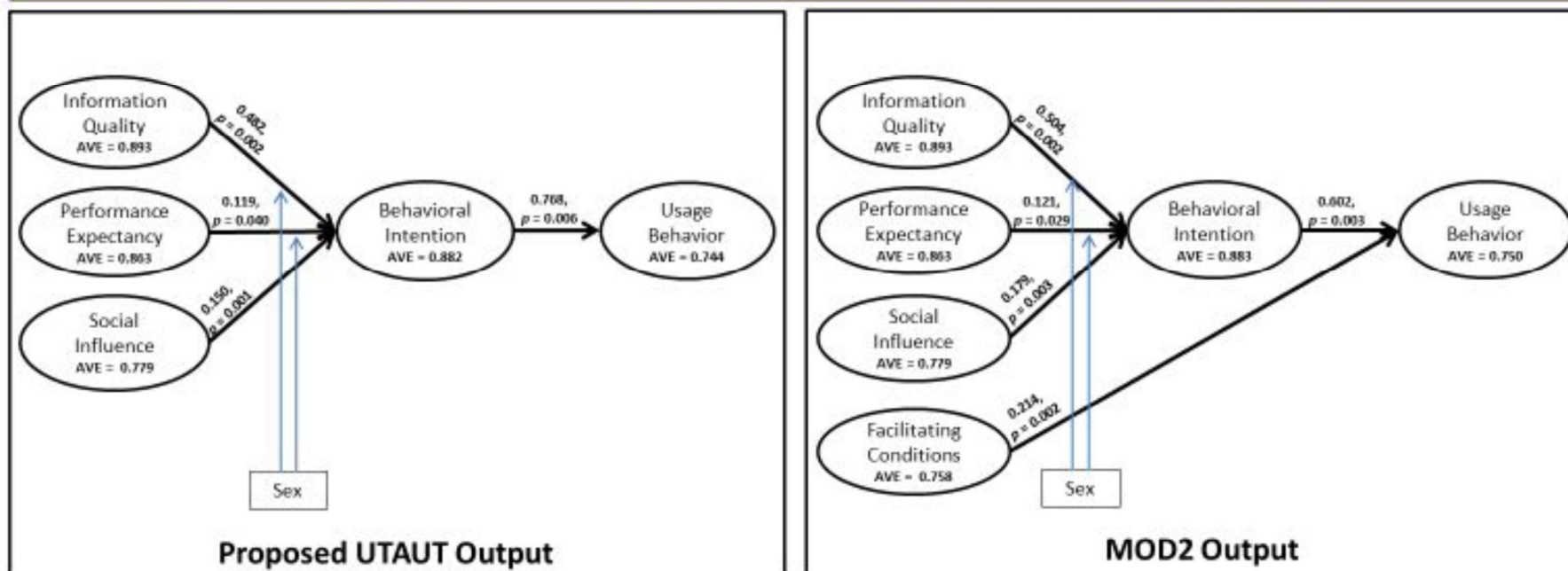
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V. CONCLUSIONS

MODELS OF BEHAVIORAL INTENTION AND USAGE BEHAVIOR OF DHCP





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VI. RECOMMENDATIONS

Limitations	Recommendations
<ul style="list-style-type: none"> Limited number of medical doctors and selected respondents' age group. 	<ul style="list-style-type: none"> <input type="checkbox"/> A study dedicated to understand the behavior of medical doctors towards DHCP is recommended. <input type="checkbox"/> A paper focusing on elderly patients of Davao Region is also recommended.
<ul style="list-style-type: none"> Limited access to COVID hospitals (government hospital) and some administrative regions 	<ul style="list-style-type: none"> <input type="checkbox"/> Researcher is also encouraging to have a study focusing of government hospitals after the pandemic. <input type="checkbox"/> A study focusing on rural areas of Davao Region is encourages as well.
<ul style="list-style-type: none"> Impact of pandemic on mindset of respondents. 	<ul style="list-style-type: none"> <input type="checkbox"/> Post pandemic study is also recommended to check if the models are still applicable after the pandemic.
<ul style="list-style-type: none"> Limited number of constructs. 	<ul style="list-style-type: none"> <input type="checkbox"/> The study was able to include 8 constructs. Future researchers are also encouraged to consider applicability of other UTAUT constructs recently established such as Habit, Hedonic Motivation, and Cost.
<ul style="list-style-type: none"> Limited study that supports other construct relationship such as $UB \leftarrow EE$ and $UB \leftarrow TR$. 	<ul style="list-style-type: none"> <input type="checkbox"/> Further investigation of constructs EE and TR is recommended for the local setting. <input type="checkbox"/> Researchers are discouraged to use "past experience" as indicator of trust if the research setting is on early stage of early adaption. Identification of other trust indicator is highly recommended.
<ul style="list-style-type: none"> Noted non-normality of data. 	<ul style="list-style-type: none"> <input type="checkbox"/> This concern was addressed in CB-SEM by using the 'bootstrapping' process of AMOS. However, it is also encouraged to validate the result using PLS-SEM which is less strict for data that are not normally distributed.
<ul style="list-style-type: none"> The assessment of moderating variables. 	<ul style="list-style-type: none"> <input type="checkbox"/> Gender specific DHCP must also be considered by the healthcare service provider. <input type="checkbox"/> The use of Multigroup Analysis is also recommended to validate if the moderating variables do not significantly affect selected construct-to-construct relationships.
<ul style="list-style-type: none"> Validity and generalizability of the two models. 	<ul style="list-style-type: none"> <input type="checkbox"/> In the light of continuous theory testing, it is recommended that validation of the two models be tested using new sets of data to establish acceptability and generalizability.



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2. Nisha, N., Iqbal, M., Rifat, A., & Idrish, S. (2016). Mobile Health Services: A New Paradigm for Health Care Systems. In *E-Health and Telemedicine Concepts, Methodologies, Tools, and Applications* (Vol. III, pp. 1551-1567). IGI Global.
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4. Hair, J. E., Black, W. C., Babin, B. J., & Anderson, R. E. (2014). *Multivariate Data Analysis* (7th Edition ed.). Pearson.
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6. Awang, Z. A Handbook of SEM using AMOS, 2012.

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