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ORIGINAL RESEARCH

Employing PLS-SEM Analysis to Examine the Mediation Role of Artificial Intelligence in Physician Experience. An Empirical Study of the Effect of the Medical Smartwatch on Physician Satisfaction

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Abstract

Objective: The rapid advancements in the Internet of Things (IoT) have allowed end users to enjoy restriction-free access to information. One of the notable developments in IoT is the introduction of wearable technologies, such as smartwatches. The growing popularity of wearable technology has made it possible for users to receive health and fitness data regardless of time or place. This study aims to examine the mediation role of artificial intelligence in physician experience toward using the medical smartwatch, particularly examining the effect of the medical smartwatch on physician satisfaction.

Methods: This study utilized a deductive research approach employing a cross-sectional design. Data was collected through online questionnaires from healthcare providers, particularly physicians in the United Arab Emirates (UAE). The Structural Equation Modelling analysis (SEM) was employed to evaluate the theoretical and final path models. This study further assessed the theoretical model using the Partial Least Squares (PLS) as it offers concurrent analysis for evaluating the structural model and enhancing result accuracy.

Results: Artificial Intelligence (AI) experience significantly influenced physicians' satisfaction. Additionally, the study provided supporting, satisfying evidence for the mediating effects of AI experience.

Conclusion: The study provided supporting evidence for the mediating effects of AI experience on physicians' satisfaction. This study bridges the gap in the literature regarding the absence of studies examining physicians' perceptions of medical smartwatch usage in the medical domain by providing a profound understanding of physicians' satisfaction and perceptions regarding smartwatch usage in the UAE.

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Keywords: Artificial Intelligence; Medical Smartwatch; Health Wearable Technology; Healthcare; Physician Satisfaction; Structural Equation Modelling; Partial Least Squares.

1. Introduction

Recently, technology has proven to have vast effects on human lives, individually and collectively, influencing nearly every facet (1-4). The most recent edition of technology is Artificial Intelligence (AI) (5). Over time, AI has witnessed massive and rapid developments that saw it being integrated into numerous sectors, including healthcare services within government sectors. AI is "the natural predispositions, genetic inheritance or learned skillsets forming the core of individual personalities" (5,6). AI implicates the use of machine-learning techniques and algorithms integrated within computer systems intended to mimic the functions of a human brain to make decisions (4,6). AI bridges the gap between patients and medical professionals (4,7). Whereas Physicians try to address patients' demands, and patients seek to satisfy their own.

The rapid advancements in the Internet of Things (IoT) have allowed end users to enjoy restriction-free access to information. One of the notable developments in IoT is the introduction of wearable technologies, such as smartwatches (7). The growing popularity of wearable technology has made it possible for users to receive health and fitness data regardless of time or place (4,8). Due to the advantages they offer regarding the health and fitness data of users, smartwatches' development and sales have seen rapid growth. The ease of connectivity to mobile phones via Bluetooth technology has led to people's mass adoption of smartwatches, where they can access several mobile features from their wrists, such as reading notifications, making phone calls, and tracking their physical activities (5, 7). There has been significant growth in demand for wearable technologies in the medical field. These devices allow users to monitor vital physical well-being indicators such as physical activity and step count, blood pressure, blood oxygen, and glucose levels. The increased need for a technology that can help people in observing health-cantered features and the rise in health awareness have ignited a notable and rapid shift of the innovation in smartwatch research and development (9).

Research performed by Counterpoint's Global Smartwatch Tracker indicated that there had been a 37% growth worldwide in smartwatch shipments in the second quarter of 2018, 41% of which was dominated by Apple (10). Additionally, since 90% of

smartwatches sold currently lack cellular capabilities, smartwatch manufacturers are attempting to integrate cellular connectivity capabilities for standalone use cases (10). Although numerous researchers have conducted studies on the usage and adaptation factors of smartwatches (9, 11-13), none of them have studied how physicians' perceptions of medical smartwatches—including their quality, adequacy, appropriateness, relevance, usability, brand, and AI experience—are influenced by these factors. This study intends to bridge this gap and provide a profound understanding of physicians' perceptions regarding smartwatch usage in the medical field in the United Arab Emirates (UAE). Essentially, this research study utilizes the integrated and innovative research approach to examine the factors that influence physicians' satisfaction with the use of Medical Smartwatches (MSW) through the role Al experience played as a mediator in this context. More specifically, the integrated and innovative research model integrates the diffusion of innovation (DOI) model, Technology Acceptance Model (TAM), and the flow model to assess the predictors of physicians' satisfaction with MSW and the impact of amplified embracing of this technology.

Moreover, the model explores how Al's experience influences physicians' satisfaction as a mediating factor. The primary objective of this study is to evaluate the success of MSW in the medical domain since a successful implementation of this technology is equally important to doctors and patients. MSW's success relies on end-users' decisions and a feedback loop of relevant information within a network of patients and doctors, which can influence attitudes and behaviors. This research builds upon previous studies investigating exogenous variables as determining factors of MSW use. Prior studies like (8-13) have explored the effect of external factors like availability and mobility on using MSW. However, this study focuses on external factors such as richness of content and innovations as the primary determinants of physicians' satisfaction with MSW. While several studies have explored the degree of acceptance of MSW, this study is the first to evaluate physicians' satisfaction with MSW use, specifically within the UAE medical field, employing an integrated research model.

2. Methods and Materials

This study utilized a deductive research approach employing a cross-sectional design. Data was collected through online questionnaires from healthcare providers in the UAE, i.e., from seven hospitals and ten primary healthcare clinics from December 14, 2021, to January 14, 2022. The researchers contacted the targeted physicians through official emails and social media platforms, including WhatsApp, to administer the questionnaires. The collected data were judged reliable as it was obtained from participants working in a healthcare setting, which is the most suitable environment for gathering information on healthcare practices (14).

Moreover, the study followed recommendations from healthcare service management studies in selecting the targeted population as the component of analysis [14-16]. The chosen sample units had sufficient familiarity with their organization's procedures and health quality [14-15]. In this study, non-probability sampling, specifically convenience sampling, was employed due to difficulties accessing comprehensive physician lists in the selected units of analysis. Moreover, convenience sampling was cost-effective and time-efficient and enabled a larger sample size to be utilized [14,16].

The authors randomly distributed two thousand questionnaires. Respondents replied to 1418 out of the initial 2000 questionnaires distributed. Ten questionnaires were rejected due to missing values resulting in 1408 completed questionnaires ready for analysis, leading to a 70.4% response rate. The sample size of 1408 in this study exceeded the suggested sample size of 323 for a population of 2000 [17]; thus, the use of Structural Equation Modelling (SEM) to test the hypotheses was justified [19]. Although the hypotheses were built upon existing models, they were structured within the framework of MSW. SEM was employed to evaluate the theoretical model and the final path model. This study assessed the theoretical model using the PLS-SEM as it offers concurrent analysis for evaluating the structural model and enhancing result accuracy [15,19].

Furthermore, PLS-SEM also helps examine the predictors of the conceptual model, contributing to information systems research as a complementary multi-analytical method. This research study will be one of the few in

the medical field using PLS-SEM to examine physicians' satisfaction with using MSW.

The survey instruments used to test for the hypotheses consisted of 47 items intended to measure ten constructs included in the questionnaire. The questions within the survey were revised and restructured, building upon previous studies (14-16, 20) to improve the generalizability of the study. To measure the 47 items, a 5-point Likert scale (1= strongly disagree; 5 = strongly agree) was used. A pilot study was conducted with 75 randomly selected participants (5.3% of the total sample) to assess the reliability of the questionnaire items. To test for the internal reliability of measurement instruments, IBM SPSS Statistics version 23 was used to perform Cronbach's alpha test. According to social science studies (9,19,21), a Cronbach's alpha coefficient of 0.7 is sufficient for questionnaire items. The performed Cronbach's alpha analysis indicated that the measurement items were adequate. Furthermore, a single-factor Harman's test was conducted with seven factors to confirm that the data were not affected by Common Method Bias (CMB) (19,21). The seven factors were then loaded into a single factor, which explained 26.54% of the variation, but fell below the 50% threshold recommended [9], indicating the absence of CMB in the collected data.

3. Data Analysis and Results

3.1 Demographic information

Table 1 presents the demographic characteristics of the study participants. The table indicates that the sample consisted of individuals from diverse genders, age groups, educational backgrounds, and work experience in various sectors. Regarding gender, 29.9% of the respondents were female, while 70.1% were male. The table also reveals that most participants (43.6%) were aged 41 to 50. Furthermore, most of the participants had achieved a high level of education. According to Table 1, 60.4% held bachelor's degrees, 22.2% had master's degrees, and 17.4% completed doctoral education. Additionally, the table indicates that 77.9% of the sample had work experience ranging from 1 to 10 years.

Table 1. The Profile of Respondents.

	Frequency	Percent (%)
Gender		
Male	987	70.1
Female	421	29.9
Age		
20-30	101	7.2
31-40	456	32.4
41-50	614	43.6
Over 51	237	16.8
Education Level		
Bachelor Degree	851	60.4
Master Degree	312	22.2
PhD Degree	245	17.4
Years of Experience		
Less than 1 Year	41	2.9
1-5 Years	798	56.7
6-10 Years	298	21.2
More than 10 Years	271	19.2
Total	1408	100.0

3.2 Convergent validity

To assess the reliability of the measurement model, Cronbach's alpha test and composite reliability were conducted. Additionally, the discriminant and convergent validity of the model were examined (21). Table 2 presents Cronbach's alpha coefficients, which range from 0.701 to 0.878, surpassing the threshold of 0.7 (22). Additionally, the composite reliability (CR) values in Table 2 range from 0.677 to 0.776, exceeding the threshold of 0.7 (23). These results confirmed the reliability of the constructs while being measurement-error-free. The average variance extracted (AVE) and factor loading were performed to evaluate Convergent validity (21). The factor loading values shown in Table 2 surpass the threshold of 0.5. However, the AVE values ranging from 0.529 to 0.845 fall short of the required 0.5 thresholds. Nevertheless, the results suggest that all constructs in the study demonstrate satisfactory convergent validity.

Table 2. Factor Loading & Cronbach's Alpha coefficient

Construct & Item No.	Cron-bach's Alpha	CR & AVE	Factor Loadings								
			F1	F2	F3	F4	F5	F6	F7	F8	F9
Relevance (REL) **5**	.831	0.748 & 0.854	.725 .827 .619 .728								

			.884								
Timeliness (TL) **4**	.712	0.736 & 0.529		.712 .754 .854 .762							
Sufficiency (SUF) **6**	.843	0.765 & 0.801			.664 .803 .876 .799 .837 .789						
Perceived Convenience (PC) **5**	.878	0.758 & 0.554				.765 .899 .654 .786 .578					
Product Quality (PQ) **5**	.782	0.677 & 0.689					.723 .738 .879 .808 .823				
Service Quality (SQ) **5**	.772	0.776 & 0.673						.754 .852 .654 .879 .811			
Usability (US) **6**	.838	0.748 & 0.776							.607. .741 .723 .760 .782 .796		
Perceive**d** Ease of Use (PEU) **5**	.759	0.761 & 0.663								.778 .761 .886 .951 .977	
AI Experien**ce**e (AI E) **5**	.701	0.756 & 0.548									.665 .762 .774 .639 .773

3.3 Causal Model Analysis & Hypotheses Testing

The present study utilized a hybrid Partial Least Squares Structural Equation Modeling (PLS-SEM) methodology using Smart PLS to assess the hypothesized relationships among variables in the proposed research model. PLS-SEM was selected due to the exploratory nature of the theoretical model

and the lack of prior related research. The study followed the general guidelines for using PLS-SEM in information systems (IS) research. It used a two-step technique that involves measurement and structural models as put forward by previous literature (24). IPMA was also used to evaluate the model's constructs in terms of relevance and practicality. The coefficient of determination (R^2) and path coefficients were used to assess the structural model's predictive accuracy. The literature indicates that R^2 is an indicator for determining a model's predictive accuracy (25). Table 3 shows p-values, t-values, and path analysis coefficients for all the hypotheses, revealing that all the hypotheses (H1 to H9) were empirically supported through the data analysis (Refer to Fig. 1).

The coefficient of determination R^2 was used to evaluate the obtained structural models where the correlation between the predicted dependent variable and the actual values were squared (25). Subsequently, R^2 indicates the degree of variation in the dependent construct. The obtained R^2 value of 0.743 indicated that the model had a high level of prediction for physicians' satisfaction towards the use of MSW, explaining 74% of the variation in satisfaction. The results illustrate that REL, TL, and SUF had a significant effect on PC ($\beta = 0.578$, $p < .05$), ($\beta = 0.478$, $p = .018$), and ($\beta =. 299$, $p < .05$) respectively (see Table 3). Accordingly, H1, H2, and H3 are supported. The results also reveal that PC, PEU, PQ, SQ, and US significantly influenced AI Experience ($\beta = 0.502$, $p < .01$), ($\beta =. 637$, $p = ,000$), ($\beta = 0.311$, $p < .01$), ($\beta = 0.539$, $p < .01$), and ($\beta = 0.662$, $p = .000$) respectively. Thus, the results support H4, H5, H6, H7, and H8. Furthermore, the results also reveal that AI Experience significantly affects physicians' satisfaction with using MSW. Consequently, H9 was confirmed (See Figure 1).

Table 3. Hypotheses-testing of the research model.

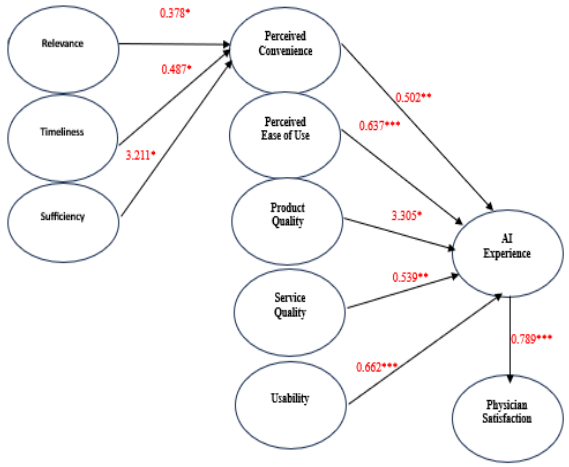
Association	Hypothesis	Path Coefficient	t- Value	P- Value	Decision
REL → PC	H1	0.378	3.887	0.041	Supported*
TL → PC	H2	0.487	4.682	0.018	Supported*
SUF → PC	H3	0.299	3.211	0.035	Supported*
PC → AIE	H4	0.502	7.549	0.001	Supported**
PEU → AIE	H5	0.637	12.479	0.000	Supported***
PQ → AIE	H6	0.311	3.305	0.032	Supported*
SQ → AIE	H7	0.539	7.367	0.002	Supported**
US → AIE	H8	0.662	13.802	0.000	Supported***

AIE → PST	H9	0.789	18.778	0.000	Supported***

Note: Relevance (REL); Timeliness (TL); Sufficiency (SUF); Perceived Convenience (PC); Product Quality (PQ); Service Quality (SQ); Usability (US); Perceived Ease of Use (PEU); AI Experiencee (AI E); Physician Satisfaction (PST).

*If a p-value is less than 0.05, it is flagged with one star (*). If a p-value is less than 0.01, it is flagged with 2 stars (**). If a p-value is less than 0.001, it is flagged with three stars (***).

Figure 1. Path Test of the Research Theoretical Model.



4. Discussion

The primary objective of this research was to examine the utilization of AI-powered smartwatches for self-health monitoring and assess how physician experience affects satisfaction by employing a novel model built upon the integrated and innovative theory to explore the factors that determine physicians' satisfaction with AI-driven MSW, with a particular focus on the mediating role played by AI experience. Data analysis revealed significant impacts of REL, TL, SUF, PC, PQ, SQ, US, and PEU on physicians' satisfaction. Furthermore, AI experience was found to influence physicians' satisfaction significantly. Additionally, the study provided supporting evidence for the mediating effects of AI experience on physicians' satisfaction. This study bridges the gap in the literature regarding the absence of studies examining physicians' perceptions of MSW usage in the medical domain by providing a profound understanding of physicians' satisfaction and perceptions regarding smartwatch usage in the UAE. The study contributes to the literature on smartwatch studies that previously examined external variables as contributing factors for MSW adoption. Several studies [9,26,27] have investigated the influence of external factors such as availability and mobility on MSW. In contrast, this study focuses on external factors like content richness and

innovations as the primary determinants affecting physician satisfaction with MSW.

This research study has established empirical evidence of a positive correlation between content richness and MSW, demonstrating that content richness plays a crucial role in achieving high satisfaction with smartwatches. Furthermore, the research findings indicate that content richness influences the increased usage of smartwatches. Specifically, content richness shows a significant positive impact on PC, which in turn affects MSW positively. These findings also align with prior studies that have emphasized the influence of quality content on PC (28,29). Additionally, this study revealed a significant impact of PQ and SQ on the levels of users' satisfaction and experience. These findings are consistent with prior research that underscores the importance of product and service quality in ensuring positive user experiences, trust, and satisfaction when utilizing such devices (30,31,32). Essentially, a product's quality reduces the disparity between the received and expected products. In the case of smartwatches, product quality encompasses various aspects, including the device's functionalities and performance. These qualities are reflected in the smartwatches' personalized content abilities, instantaneous support, up-to-date information, and seamless user interaction (9, 33). On the other hand, service quality pertains to the reliability with which smartwatches are designed to handle users' personal and health information and their capability to accurately detect and monitor conditions like hypertension, diabetes, irregular heart rates, and other diseases safely and securely (34).

In terms of the reduced time and effort required for usage, this study revealed that PC significantly influences physicians' trust, experience, and satisfaction. These findings are consistent with the research conducted by Pham et al. (35). Additionally, several studies have emphasized that physicians' satisfaction is positively correlated with the convenience of having readily available medical information and services (36), real-time information accessibility and assistance, as well as advanced guidance (9,14,15). Such information's time and place restriction-free features become crucial in emergencies like the COVID-19 pandemic. Enhancing the overall user experience is achieved through the positive contributions offered by self-service, real-time, and time-saving

convenience (14-16). Moreover, service convenience is crucial in inspiring users to actively utilize products such as smartwatches to attain a good and memorable experience (37,38). In addition to facilitating a favorable experience, the convenience offered by AI-powered smartwatches fosters a sense of trust among smartwatch users. By eliminating barriers, promoting a sense of satisfaction for users, and evaluating service efficacy, user trust is cultivated, which as in turn, encourages users to utilize AI-powered devices such as smartwatches (33-38).

Regarding perceived ease of use (EEU), the study's results affirmed its significance concerning user satisfaction, trust, and user experience. These findings align with previous studies conducted by Jarrahi (39). Having older users who may have lower proficiency with technology highlights the importance of the perceived ease of use construct. Users, especially older ones, feel more at ease using devices like smartwatches if they are designed to be user-friendly, simple to handle, and require minimal effort for maintenance. Thoughtfully crafted layouts, intuitive navigation, and visually pleasing designs that prioritize simplicity and user-friendliness help minimize physical effort and reduce mental strain, ultimately resulting in positive user experiences (9-16). With repeated use, users become more familiar with the technology, enhancing their confidence and fostering trust. Moreover, the synchronization function with physicians' smartphones proves to be more practical than a fitness tracker, especially when they need to navigate traffic congestion while riding a motorcycle. This feature allows them to determine whether an incoming call is significant enough to warrant pulling over safely.

Our data analysis confirmed the mediating role of AI experience in influencing physicians' satisfaction. The study revealed significant PQ, SQ, PC, US, and PEU effects on both experience and user satisfaction. Furthermore, the study demonstrated that these predictors also had substantial indirect effects on satisfaction when mediated by AI experience. In other words, experience acted as a partial mediator in these relationships. Positive experiences with AI-powered smartwatches in the user AI experience context directly enhance the relationships between predictors (PQ, SQ, PC, US, and PEU) and physician satisfaction. These results are consistent with previous empirical

research studies that have recognized the significance of AI experience construct as a mediator (40). In healthcare, empirical evidence indicates that prior experience significantly reinforces the relationships between several factors, including satisfaction with using AI-powered devices [31-40). From a practical standpoint, individuals who have had positive past experiences using AI-powered smartwatches to monitor their health conditions and receiving endorsements from medical professionals regarding such devices will likely experience improved satisfaction.

Finally, it is essential to acknowledge the limitations of this study. First, the use of a purposive sampling technique restricts the findings' generalizability to 40 years old or above users, where the sample was dominated by male respondents (41-49). Additionally, respondents were selected from just three emirates within UAE. Future studies should utilize random sampling techniques and include a more comprehensive range of locations, including developing countries. Expanding the sampling coverage to encompass a broader range of individuals would ensure a more accurate population representation. It is also crucial to provide a more balanced picture of both male and female respondents in the sample. Additionally, future research should consider incorporating alternative theories, such as the Unified Theory of Acceptance and Use of Technology (UTAUT). Lastly, future models can explore the impact of AI-enabled smartwatches on various types of diseases and the potential for device personalization.

5. Conclusion

This study holds significant importance in shedding light on using the e-doctor concept through AI-powered smart devices, including smartwatches. The findings further contribute to the body of literature aiming to understand physicians' satisfaction and optimal utilization of AI-enabled devices in healthcare and related domains. While AI technology continues to evolve and essential services like healthcare become more accessible to a broader population, self-managing one's health becomes increasingly crucial. Brands should therefore strive to make their products and services more adaptable by comprehending user behaviors and their use patterns, ultimately ensuring effective utilization and user satisfaction.

References

1. Taryam M, Alawadhi D, Al Mar-zouqi A, Aburayya A, Albaqa'een A, Alfarsi A, et al. The impact of the covid-19 pandemic on the mental health status of healthcare providers in the primary healthcare sector in Dubai. Linguist Antwerp. 2021;21:2995-3015.
2. Mouzaek E, Marzouqi A, Alaali A, Salloum N, Aburayya S, Suson A. An Empirical Investigation of the Impact of Service Quality Dimensions on Guests Satisfaction: A Case Study of Dubai Hotels. Journal of Contemporary Issues in Business and Government. 2021;27(3):1186–99.
3. Capuyan DL, Capuno RG, Suson R, et al. Adaptation of innovative edge banding trimmer for technology instruction: A university case. World Journal on Educational Technology: Current Issues. 2021; 13: 31–41.
4. Aburayya A, Marzouqi A, Iyadeh I, Albqaeen A, Mubarak S. Evolving a Hybrid Appointment System for Patient scheduling in Primary Healthcare Centres in Dubai: Perceptions of Patients and Healthcare Providers. International Journal on Emerging Technologies. 2020;11(2):251-260.
5. Zhang, Weidong et al. Factors influencing the use of artificial intelligence in government: Evidence from China.Technology in Society. 2021; 66: 101675.
6. Vishnoi SK, Bagga TE, Sharma AA, Wani SN. Artificial intelligence enabled marketing solutions: A review. Indian Journal of Economics & Business. 2018;17(4):167-77.
7. Uzir, Uzir Hossain et al. Applied Artificial Intelligence and user satisfaction: Smartwatch usage for healthcare in Bangladesh during COVID-19. Technology in Society. 2021; 67: 101780 - 101780.
8. Longo L. Empowering qualitative research methods in education with artificial intelligence. InWorld Conference on Qualitative Research 2019 Sep 17 (pp. 1-21). Cham: Springer International Publishing.
9. Almarzouqi, Amina et al. Determinants of intention to use medical smartwatch-based dual-stage SEM-ANN analysis. Informatics in Medicine Unlocked. 2022; 28: 100859.
10. Anggraini N, Kaburuan ER, Wang G, Jayadi R. Usability study and users' perception of smartwatch: Study on Indonesian customer. Procedia Computer Science. 2019 Jan 1;161:1266-74.
11. Lamb K, Huang HY, Marturano A, Bashir M. Users' privacy perceptions about wearable technology: examining influence of personality, trust, and usability. InAdvances in Human Factors in Cybersecurity: Proceedings of the AHFE 2016 International Conference on Human Factors in Cybersecurity, July 27-31, 2016, Walt Disney World®, Florida, USA 2016 (pp. 55-68). Springer International Publishing.
12. Karlsson Fiona. assessing Usability Evaluation Methods for Smartwatch Applications. KTH Royal Institute of Technology. 2016; 18: 1-23.
13. Wu Y, Cheng J, Kang X. Study of smart watch interface usability evaluation based on eye-tracking. InDesign, User Experience, and Usability: Technological Contexts: 5th International Conference, DUXU 2016, Held as Part of HCI International 2016, Toronto, Canada, July 17–22, 2016,

Proceedings, Part III 5 2016 (pp. 98-109). Springer International Publishing.
14. Almarzouqi A, Aburayya A, Salloum SA. Determinants predicting the electronic medical record adoption in healthcare: A SEM-Artificial Neural Network approach. PloS one. 2022 Aug 16;17(8): e0272735.
15. Almarzouqi A, Aburayya A, Salloum SA. Prediction of user's intention to use metaverse system in medical education: A hybrid SEM-ML learning approach. IEEE access. 2022 Apr 21;10:43421-34.
16. Alawadhi M, Alhumaid K, Almarzooqi S, Aljasmi S, Aburayya A, Salloum SA, Almesmari W. Factors affecting medical students' acceptance of the metaverse system in medical training in the United Arab Emirates. South Eastern European Journal of Public Health (SEEJPH). 2022 Jul 25.
17. V Krejcie R, Morgan DW. Determining sample size for research activities. EducPsychol Meas. 1970;30(3):607–10.
18. Chuan CL, Penyelidikan J. Sample size estimation using Krejcie and Morgan and
19. Cohen statistical power analysis: a comparison. J. Penyelid. IPBL 2006;7:78–86.
20. Aburayya A, Salloum S, Alderbashi K, Shwedeh F, Shaalan Y, Alfaisal R, Malaka S, Shaalan K. SEM-machine learning-based model for perusing the adoption of metaverse in higher education in UAE. International Journal of Data and Network Science. 2023;7(2):667-76.
21. Hair J, Hollingsworth CL, Randolph AB, Chong AYL. An updated and expanded assessment of PLS-SEM in information systems research. Ind Manag Data Syst. 2017;117(3):442–58.
22. Nunnally JC, Bernstein IH. Psychometric theory. 1994.
23. Kline RB. Principles and practice of structural equation modeling. Guilford publications; 2015.
24. Simpson PK. Artificial neural systems. Pergamon press; 1990.
25. Hair Jr JF, Hult GTM, Ringle C, Sarstedt M. A primer on partial least squares structural equation modeling (PLS-SEM). Sage Publications; 2016.
26. Anggraini N, Kaburuan ER, Wang G, Jayadi R. Usability study and users' perception of smartwatch: Study on Indonesian customer. Procedia Computer Science. 2019 Jan 1;161:1266-74.
27. Chuah SH, Rauschnabel PA, Krey N, Nguyen B, Ramayah T, Lade S. Wearable technologies: The role of usefulness and visibility in smartwatch adoption. Computers in Human Behavior. 2016 Dec 1;65:276-84.
28. Hong J-C, Lin P-H, Hsieh P-C. The effect of consumer innovativeness on perceived value and continuance intention to use smartwatch. Comput Hum Behav 2017;67:264–72.
29. Wibowo A, Chen S-C, Wiangin U, Ma Y, Ruangkanjanases A. Customer behavior as an outcome of social media marketing: the role of social media marketing activity and customer experience. Sustainability 2021;13(1):189.
30. Saratchandran V. Artificial intelligence (AI): Ways AI is redefining the future of customer service. Saatavilla:< https://becominghuman. ai/artificial-intelligenceai-ways-ai-is-redefining-the-future-of-customer-service-4dc667bfa59>. Viitattu. 2019;29:2021.
31. Bogicevic V, Bujisic M, Bilgihan A, Yang W, Cobanoglu C. The impact of

traveler-focused airport technology on traveler satisfaction. Technological Forecasting and Social Change. 2017 Oct 1;123:351-61.

32. Keiningham T, Aksoy L, Bruce HL, Cadet F, Clennell N, Hodgkinson IR, Kearney T. Customer experience driven business model innovation. Journal of Business Research. 2020 Aug 1;116:431-40.
33. Baier D, Rese A, Röglinger M, Baier D, Rese A, Röglinger M. Conversational User Interfaces for Online Shops? A Categorization of Use Cases. InICIS 2018 Dec 13.
34. Ameen N, Tarhini A, Reppel A, Anand A. Customer experiences in the age of artificial intelligence. Computers in Human Behavior. 2021 Jan 1;114:106548.
35. Pham Q, Tran X, Misra S, Maskeliūnas R, Damaševičius R. Relationship between Convenience, Perceived Value, and Repurchase Intention in Online Shopping in Vietnam. Sustainability [Internet] 2018;10(2):156. Available from: http://dx.doi.org/10.3390/su10010156.
36. K. Walch, AI's Increasing Role in Customer Service, 2019. https://www.forbes.
37. Ameen N, Tarhini A, Reppel A, Anand A. Customer experiences in the age of artificial intelligence. Computers in Human Behavior. 2021 Jan 1;114:106548.
38. Van Doorn J, Lemon KN, Mittal V, Nass S, Pick D, Pirner P, Verhoef PC. Customer engagement behavior: Theoretical foundations and research directions. Journal of service research. 2010 Aug;13(3):253-66.
39. Zhu Wenli, et al. Factors Influencing Users' Adoption of Mobile Computing. Managing E-Commerce and Mobile Computing Technologies, edited by Julie R. Mariga, IGI Global. 2003: 260-271. https://doi.org/10.4018/978-1-93177-746-9.ch018.
40. Afaq Z, Gulzar A, Aziz S. The effect of atmospheric harmony on re-patronage intention among mall consumers: the mediating role of hedonic value and the moderating role of past experience. Journal of Consumer Marketing. 2020 May 6;37(5):547-57.
41. Ravikumar R, Kitana A, Taamneh A, Aburayya A, Shwedeh F, Salloum S, et al. The Impact of Big Data Quality Analytics on Knowledge Management in Healthcare Institutions: Lessons Learned from Big' Data's Application within The Healthcare Sector. South Eastern European Journal of Public Health (SEEJPH) [Internet]. 2022 Dec 22 [cited 2023 Apr 27]; Available from: https://www.seejph.com/index.php/seejph/article/view/309
42. Rejitha Ravikumar AKATAAFSSSKS. Impact of knowledge sharing on knowledge Acquisition among Higher Education Employees. Computer Integrated Manufacturing Systems [Internet]. 2022 Dec 9 [cited 2023 Apr 27];28(12):827–45. Available from: http://cims-journal.com/index.php/CN/article/view/462
43. Shwedeh F, Hami N, Zakiah S, Baker A. Effect of Leadership Style on Policy Timeliness and Performance of Smart City in Dubai: A Review.
44. Shwedeh F, Hami N, Bakar SZA, Yamin FM, Anuar A. The Relationship between Technology Readiness and Smart City Performance in Dubai. Journal of Advanced Research in Applied Sciences and Engineering Technology [Internet].

2022 Dec 23 [cited 2023 Apr 27];29(1):1–12. Available from: https://semarakilmu.com.my/journals/index.php/applied_sciences_eng_tech/article/view/996

45. Shwedeh F, Adelaja AA, Ogbolu G, Kitana A, Taamneh A, Aburayya A, et al. Entrepreneurial innovation among international students in the UAE: Differential role of entrepreneurial education using SEM analysis. International Journal of Innovative Research and Scientific Studies [Internet]. 2023 [cited 2023 Apr 27];6(2):266–80. Available from: https://ideas.repec.org/a/aac/ijirss/v6y2023i2p266-280id1328.html
46. Shwedeh F, Aburayya A, Alfaisal R, Adelaja AA, Ogbolu G, Aldhuhoori A, et al. SMEs’ Innovativeness and Technology Adoption as Downsizing Strategies during COVID-19: The Moderating Role of Financial Sustainability in the Tourism Industry Using Structural Equation Modelling. Sustainability 2022, Vol 14, Page 16044 [Internet]. 2022 Dec 1 [cited 2023 Apr 27];14(23):16044. Available from: https://www.mdpi.com/2071-1050/14/23/16044/htm
47. Dahu BM, Aburayya A, Shameem B, Shwedeh F, Alawadhi M, Aljasmi S, et al. The Impact of COVID-19 Lockdowns on Air Quality: A Systematic Review Study. South East Eur J Public Health [Internet]. 2023 Jan 24 [cited 2023 Apr 27]; Available from: https://seejph.com/index.php/seejph/article/view/312
48. Abdullah El Nokiti KSSSAAFS& BS. Is Blockchain the answer? A qualitative Study on how Blockchain Technology Could be used in the Education Sector to Improve the Quality of Education Services and the Overall Student Experience. Computer Integrated Manufacturing Systems [Internet]. 2022 Nov 14 [cited 2023 Apr 27];28(11):543–56. Available from: http://cims-journal.com/index.php/CN/article/view/237
49. Salloum S, Al Marzouqi A, Alderbashi KY, Shwedeh F, Aburayya A, Rasol M, et al. Sustainability Model for the Continuous Intention to Use Metaverse Technology in Higher Education: A Case Study from Oman. Sustainability 2023, Vol 15, Page 5257 [Internet]. 2023 Mar 16 [cited 2023 Apr 27];15(6):5257. Available from: https://www.mdpi.com/2071-1050/15/6/5257/htm