AMBHigh: A User Ergonomic Mobile Learning Application Intended for Business Management Secondary Students in the Philippines

Valerie B. Peralta, Jerran R. Del Mundo, Patrick James M. Palma, Bert Regin S. Santiago, Cohesir V. Sims, Francis I. Sulit, Yoshiki B. Kurata*
Industrial Engineering Department
Technological Institute of the Philippines – Quezon City
Quezon City, Philippines
valerie.peralta37@gmail.com, yoshiki_kurata@yahoo.com, ybkurata@gmail.com, bertsantiago141@gmail.com, jerrandelmundo@gmail.com, cohesir.123@gmail.com, pjmpalma@gmail.com, f_sulit1980@yahoo.com

Abstract

Mobile Learning Application (MLA) is an accommodating technology to instructors wherein their lessons and other usable features in teaching can be done and applied online. In the Philippines, the application of this technology seems to be still lacking, most especially among high school students in government-owned institutions. At present, the subject of this study uses an online application to help senior high school students focusing on accounting and business management to review and understand their lessons further. Based from the SUS survey, the current mobile application utilized has a computed mean score of 55.25%, which is below the 68% marginal average scale for a usable system. This study aims to identify the statistically-significant variables affecting the usability of a mobile learning application to enhance its efficiency and effectiveness in improving the user experience of the students. Recommendations in this study uses the significant variables in creating an ergonomically-designed mobile learning application that will improve its user effectiveness and its usability to be utilized as a student-centered academic learning portal.

Keywords
Usability, Mobile Learning Application, Ergonomics, Senior High School, Academics

1. Introduction

In the Philippines, a vast amount of senior high school enrolments were recorded nationwide, with over one million students are expected annually to enter in government-owned schools [1]. Out of the possible enrolments in this sector, Accounting and Business Management (ABM) is the third most considered senior high school strand with recorded 219,313 enrollees [2]. ABM strand gives an understanding in relation to fields such as marketing, economics, accountancy, and business management. ABM strand helps senior high school students be more familiar in what they may face before entering college and working in the corporate industry.

Senior High School education in the Philippines is starting to integrate technology-based education to the usual teaching method. As technology advances, schools have adopted the utilization of gadgets such as smartphones as a teaching tool which comprises mobile learning applications relative to the needs of the user. Mobile Learning Application (MLA) is one of the tools that was used in the Philippines to facilitate the learning of the students. In connection, the usability of the mobile learning application is one of the key factors in order to meet the satisfaction of users. Quality of the system can affect the User Experience (UX) satisfaction in which gives a user-friendly User Interface (UI).

The study will focus on the usability evaluation of a mobile learning application intended for business management senior high school students in the Philippines. Based on the computed mean of SUS questionnaire, the current mobile

learning application only has a mean score of 55.25%, which is less than the 68% marginal mean score for a usable system, hence, the score entails for an improvement of the application. The (1) effectiveness and efficiency, (2) appropriateness, and (3) display characteristics of the mobile application are the observed significant factors that make the system less usable. This research paper aims to improve the usability of the mobile learning application through modification of the content and user interface of the application based on ergonomic concepts of a mobile application.

2. Literature Review

In developing countries in Asia, including the Philippines, mobile phones were utilized as a doable solution for the challenge in delivery of quality education [3] Mobile technology can break the educational systems wide open as it offers a variety of features and benefits, engaging students in new ways to make the educational experience more meaningful. [4] The use of mobile learning platform is given a value through the implicit memory or memory picked up indirectly as a result of being in a particular situation or environment and rarely conscious recall. [5] Mobile technology allows users to communicate instantly, an important characteristic that plays a role in a learning environment and motivates students to participate in a collaborative class discussion. [6]

Learning content should be assessed from a quality perspective metric which identifies what content could be effectively delivered in the learning environment and why it should be taught in this context. It should also provide content that is both optimized for mobile delivery and justifies delivery through the mobile channel. [7] Mobile learning application should have closely integrated the concepts to be learned and the content of the application and not just providing learners with a handy and individualized game-based environment to enhance their motivation and engagement. [8] Efficient design and elaboration by application software are necessary to create teaching strategies and learning scenarios. The steps and procedures of the aforementioned teaching strategies were all fairly complex, which allows teachers with no programming skills to flexibly and efficiently implement mobile-assisted education through the software. [9]

3. Research Design and Methodology

The table shows the summary of demographics wherein fifty-two percent of the users are males and most of the respondents are in the seventeen (17) years of age bracket. Table 1 displays the frequency of how the students use their mobile phone as a tool and forty-five percent (45%) of the students said that they use their phones less than an hour as an educational device.

Table 1. Demographics of Sample

DEMOGRAPHICS	FREQUENCY	PERCENTAGE
GENDER		
Male	17	52%
Female	16	48%
AGE		
17 years old	19	58%
18 years old	12	36%
19 years old	1	3%
38 years old	1	3%
MOBILE PHONE USER		
Yes	30	91%
No	3	9%
MOBILE PHONE USAGE		
Educational Related		

>1 hour	15	45%
2-3 hours	11	33%
<3 hours	3	9%
n/a	4	12%

The pre-evaluation of the usability of a mobile learning application requires a preliminary questionnaire that will focus on the usability of the system. To analyze the usability of a mobile application, human and user satisfaction factors are used to identify the needs of the application for improvement. The factors are subjected to creating usability assessment questionnaires which will be used for identifying the significant factors in the usability of the mobile application. Statistical tools are utilized to test the normality, correlation, and regression between factors identified. The main causes of less usable application will be used as an avenue to develop improvements within the user interface and the content of the application.

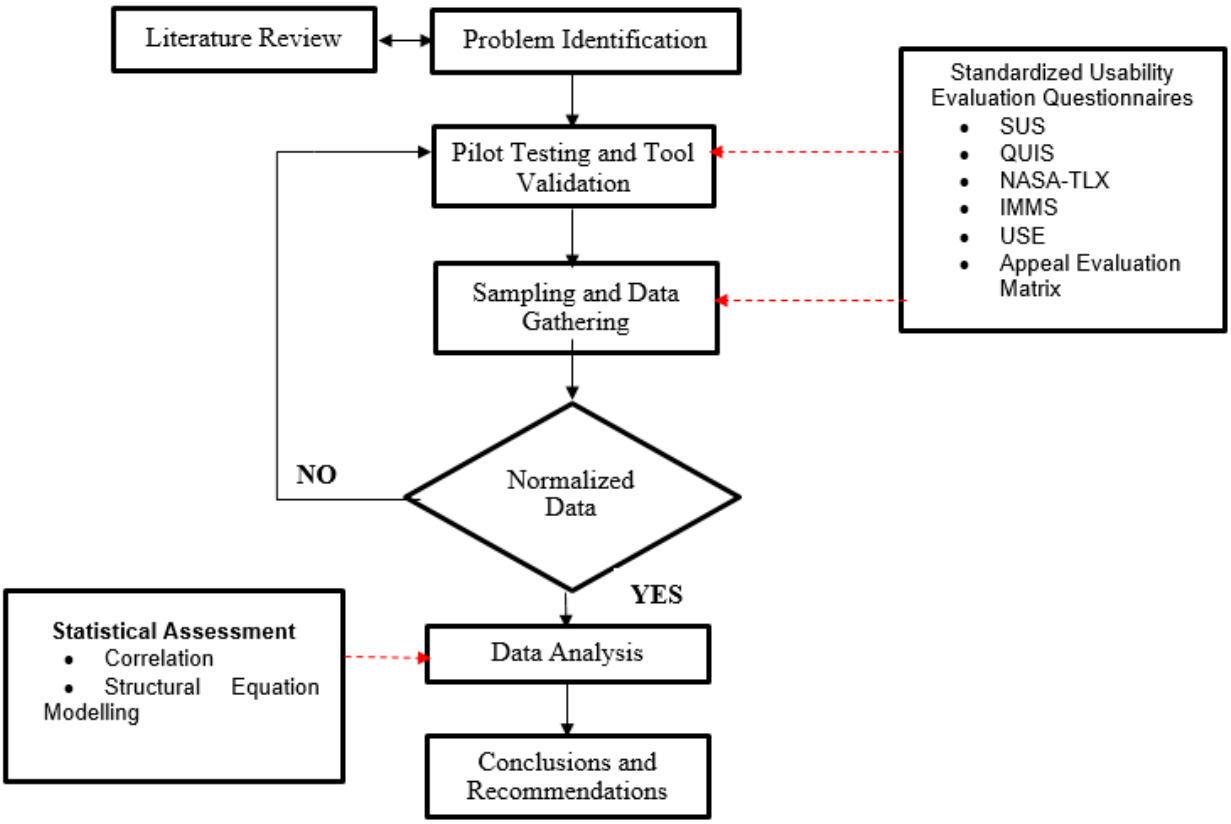


Figure 1. Methodology

4. Results and Discussion

The data underwent statistical treatment to determine whether the distribution of data is normal, the correlation of between factors identified in the study, and the path analysis relationship of the factors.

4.1. Normality Test

The graph and tabulated data are shown below explains the distribution of the data. In the tool Kolgomorov-Smirnov test in IBM SPSS Statistics, data is concluded as normal if the p-value of given data is greater than the alpha level of 0.05. With a total of 33 respondents, the p-value resulted to .200. Therefore, the given sample has a normal distribution.

Table 2. IBM SPSS Statistics – Test of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Usability	.095	33	.200*	.972	33	.533

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

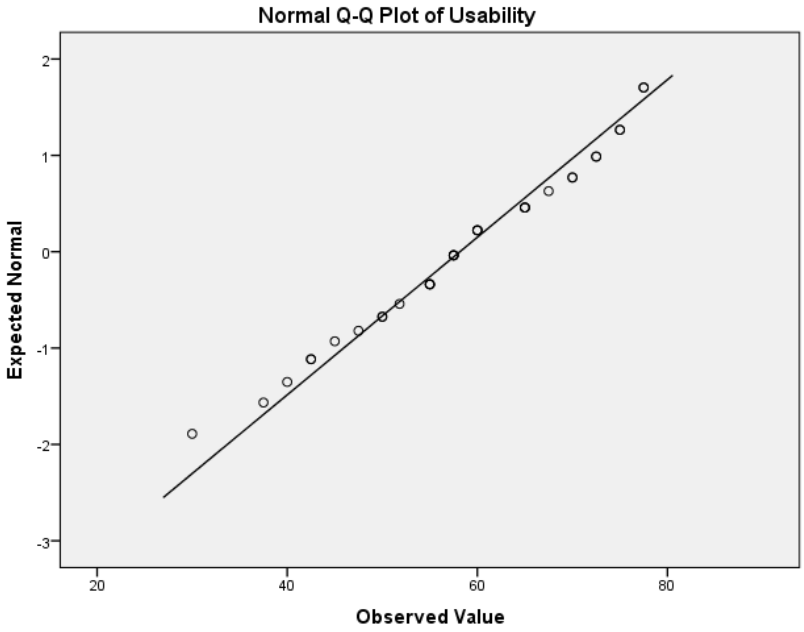


Figure 2. Normality Plot of Usability

4.2. Pearson's Correlation

The relationship of effectiveness and efficiency, display characteristics, system capabilities, comprehensibility, adaptability, learnability, and appeal has an average of positive moderate correlation to the other factors. Both appropriateness and motivation havehave a low correlation to other independent factors. Only, the workload has an average of very weak correlation with other independent factors.

4.3. Structural Equation Modelling

Structural Equation Modelling outputs the model fit of the path analysis diagram which is significant on proving the interpretation of data. The table below shows the model fit of baseline comparisons. A model has a very good fit if the NFI, RFI, IFI, TLI and, CFI is close to 1. Since the values are satisfied as seen on the table, the model is said to have a good model fit.

Table 3. Baseline Comparison

MODEL	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default Model	1.000		1.000		1.000
Saturated Model	1.000		1.000		1.000
Independence Model	.000	.000	.000	.000	.000

The figure below shows good path analysis model. The model satisfied the modification indices, NFI, RFI, IFI, TLI, and CFI.

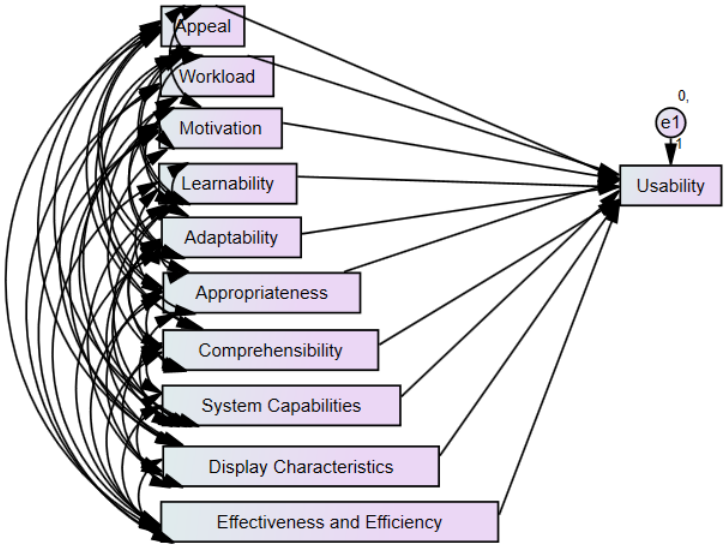


Figure 3. Path Analysis

The table below comprises of the regression weights of each factor which explains that a p-value lower than the alpha level of 0.05 has a significant relationship to the dependent variable. Appropriateness, display characteristics, and effectiveness and efficiency are the significant factors affecting the usability of the application.

Table 4. Regression Weights

			Estimate	S.E.	C.R.	P
Usability	<---	Appeal	-4.110	2.156	-1.906	.057
Usability	<---	Workload	.174	.096	1.821	.069
Usability	<---	Motivation	2.262	2.446	.925	.355
Usability	<---	Learnability	.368	2.361	.156	.876
Usability	<---	Adaptability	-1.255	1.141	-1.100	.271
Usability	<---	Appropriateness	4.215	1.586	2.658	.008
Usability	<---	Comprehensibility	-3.402	2.576	-1.321	.187
Usability	<---	System Capabilities	-2.010	2.356	-.853	.393
Usability	<---	Display Characteristics	4.169	1.642	2.539	.011
Usability	<---	Effectiveness & Efficiency	11.542	3.431	3.364	***

5. Conclusion

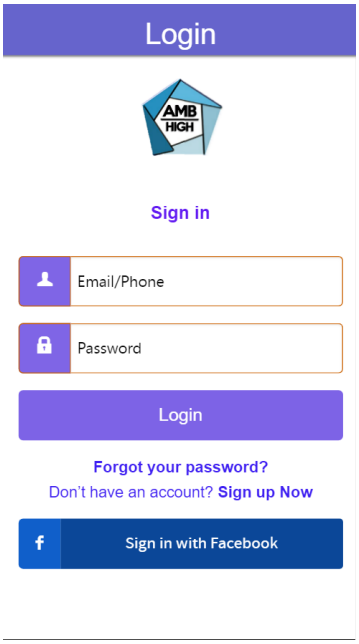
In this study, the researchers focus on developing the usability of the said mobile application intended for secondary students in the Philippines. Applying ergonomic principles helps the proponents to improve the usability by using different measuring tools such as standardized survey questionnaires intended for measuring the usability of any system. Assessment on the negative factors affecting the present mobile learning application is one way to determine the unnecessary buttons and negative behavior while using the application that may affect the functionality and full potential of it. Trough development, it gives chance to both students and teachers to have better and advance way of communication and it enhances the learning experience of the user. Based on the results of the system usability scale (SUS) survey it has only fifty-five and twenty-five percent (55.25 %) which means that it is below the acceptable marginal scale of sixty-eight percent (68%) therefore, there is a room for improvement to make it more usable, effective and efficient at the same time. To improve the usability, the independent factors should be the main focus of the changes such as appeal, workload, screen, adaptability, comprehensibility, motivation, and system capability; improving these factors will make the understanding of the users better.

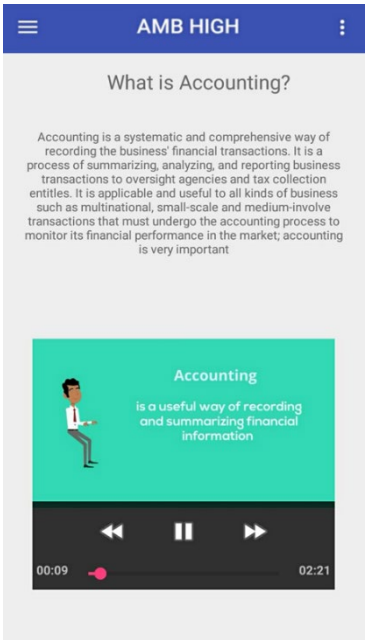
6. Recommendation

The factors that shows significance to the usability evaluation of the application are: 1) Effectiveness & Efficiency, 2) Appropriateness, and 3) Display Characteristics. The addressed factors are needed to improve for the developing the usability of the application. Thus, the researchers recommend the following changes:

Table 5. Summary of Comparative Analysis of Recommendations

PAGE	PRESENT	PROPOSED
SIGN-IN PAGE	There are unnecessary information indicated	Necessary personal sign-up information
ABOUT US PAGE	There are too many information indicated about the application and company.	The information about the application and company contains only a brief description.
CONTENT PAGE	There are excessive buttons that does not add to the functionality of the app.	Removed the unnecessary buttons to lessen the confusion on the user's perspective
QUIZ PAGE	Fonts on the interface intimidate the reader.	Makes the font comfortable to make the user interface and user experience enjoyable.
VIDEO TUTORIAL PAGE	There are no visual-audio tutorials	The app now contains other learning materials, tutorials, and guidelines.
AUDIO PAGE	There are no audio voice	The app now contains an audio voice of learning content.





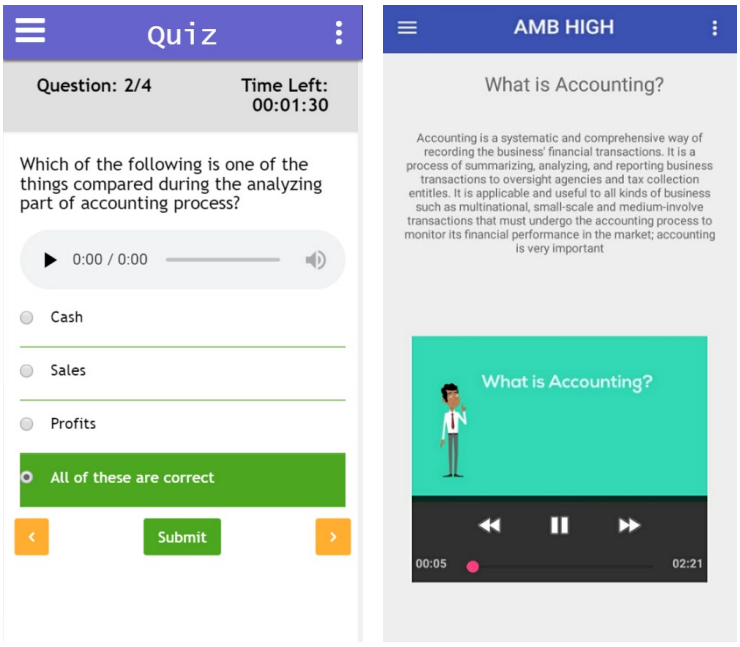


Figure 4. Proposed Design

In the proposed design of sign-in page, the usual sign-in page of applications that requires log-in was used to implicit simplicity and directness. Log-in through Facebook was also added to lessen the hassle of making a new account. The proposed About Us page includes the purpose of making the application. The new content page only comprises of the lesson being discussed. Video presentations about the lesson was instated to help the user understand the discussion through visual learning. The proposed quiz page had an audio file of the question and the choices for the answers had a comfortable font style for the user.

References

[1] Geronimo, J.Y (2016, May 30) 1.5M students to enter senior high's Grade 11. Retrieved from https://www.rappler.com
[2] Accountancy, Business and Management (ABM) Strand. (2016, September). Retrieved from https://www.edukasyon.ph/courses/senior-high-tracks/academic/abm-accountancy-business-and-management-strand
[3] Elder, L., Rashid, A.T., and Valk, J.H., *Using mobile phones to improve educational outcomes: An analysis of evidence from Asia, The International Review of Research in Open and Distributed Learning* 11-1, pp 117-140, 2010
[4] S. McQuiggan et al., *A Handbook for Developers, Educators, and Learners,* 2015
[5] Caine, G., et. al., *12 Brain/Mind Learning Principles in Action,* Thousand Oaks, CA: Corwin Press, 2005
[6] Järvelä, S., *Social and Emotional Aspects of Learning,* 1st Edition, 2007
[7] Parsons, D., Ryu, H., *A Framework for Assessing the Quality of Mobile Learning,* 2006
[8] Ketamo, H. *mLearning for Kindergarten's Mathematics Teaching,* Proceeding of IEEE International Workshop on Wireless and Mobile Technologies in Education, August 2002, Växjö, Sweden, pp. 167-170, 2002
[9] Chang, K.E., Lan, Y.J., and Sung, Y.T., *A mobile-device-supported peer-assisted learning system for collaborative early EFL reading,* Learning and Technology, 2007

Biographies

Valerie B. Peralta is currently an Industrial Engineering student at Technological Institute of the Philippines – Quezon City and an undergraduate of Electronics and Communications Engineering. She studied Practical and Industrial Electronics at MFI Polytechnic Institute Inc. She is a proud member of Orients (Organization of Industrial Engineering Students), PIIE (Philippine Institute of Industrial Engineers) and ORSP (Operations Research Society of the Philippines) and a previous member of IECEP (Institute of Electronics Engineers of the Philippines). She started her career as a Quality Analyst in a Business Process Outsourcing Company and is a volunteer for the Philippine Red Cross and partaken in various Outreach Programs. She participated in several research projects about Ergonomics Usability, SWOT Analysis, Increasing Productivity, Manufacturing, Research, Lean Six Sigma Application and DMAIC Approach and Optimization for Operations.

Jerran R. Del Mundo is an Industrial Engineering student of Technological Institute of the Philippines. Previously, he was an Electronics and Communication Engineering student on Far Eastern University Institute of Technology from year 2014 to 2016 and shifted to TIP as Industrial Engineering student. In school year 2017 to 2018, he was elected as the secretary of Campus Christian Fellowship, a Christian organization affiliated in Inter-Varsity Christian Fellowship and in year 2018 to 2019, he was elected as the president of the same organization. He is a member of Organization of Industrial Engineering Students (ORIENTS) TIP-QC. He underwent a two-week-long training program on discipleship and leadership organized by IVCF Metro Manila Regional Unit.

Palma, Patrick James M. is an Industrial Engineering Student at Technological Institute of the Philippines, Quezon City. He is currently a member of Orients- Organization of Industrial Engineering Students and also a member of Philippine Institute of Industrial Engineers.

Bert Regin S. Santiago is a former student of Concepcion Integrated School in Marikina city where he also a member of Boy Scout of the Philippines in which he got a rank of Pathfinder. In that time he also joined to a camping in Los Banos, Laguna, Mt. Makiling Forest Reserve. He is also a member of Red Cross of the Philippines Marikina city chapter. He is now studying in Technological Institute of the Philippines, Quezon City in which he is an active of member of ORIENTS (Organization of Industrial Engineering Students), PIIE (Philippine Institute of Industrial Engineers) and ORSP (Operation Research Society of the Philippines). He also a participant of ECE Roadshow Collision 2018 in DTTB seminar.

Cohesir V. Sims is a student in Technological Institute of the Philippines taking Bachelor in Science in Industrial Engineering. Formerly represented Industrial Engineering in Interdepartmental Science Quizbee and also a former officer in Citizen Army Training. Joined various outreach and seminars. He is a member of ORIENTS (Organization of Industrial Engineering Students), PIIE (Philippine Institute of Industrial Engineers) and ORSP (Operations Research Society of the Philippines).

Francis I. Sulit is a bonafide Industrial Engineer. He finished Bachelor of Science in Industrial Engineering and Master of Science in Engineering Education major in Industrial Engineering. He is formerly an employee of Daiichi Electronics Manufacturing Corporation, Red Ribbon Bakeshop, Inc. and Purefoods Hormel Corporation before moving into the academe. Currently, he is a full-time Master Teacher of a government secondary school and also works in Technological Institute of the Philippines and Siena College as Instructor. He is working under the College of Engineering and Information Technology and handles subjects like Principles of Economics, Production Systems, Industrial Psychology and Advanced Statistics.

Yoshiki B. Kurata is a Certified Industrial Engineer (CIE) awarded by the Philippine Institute of Industrial Engineers (PIIE) and an Associate ASEAN Engineer (AAE) awarded by the ASEAN Federation of Engineering Organizations. Currently, he is an Assistant Professor in the Department of Industrial Engineering and a Professor of the Graduate School Program in the Technological Institute of the Philippines – Quezon City. He earned his B.S. in Industrial Engineering from the University of Santo Tomas, Manila, Philippines and Master of Science in Industrial Engineering from the University of the Philippines Diliman, Quezon City, Philippines. He has published several journal and conference papers in human factors and ergonomics, production optimization, operations research, and service system operations. His research interests include ergonomics, production systems, technopreneurship, and service science. At present, he is the president of the Philippine Institute of Industrial Engineers – Young Engineers Section (PIIE-YE).