The International Journal of E-Learning and Educational Technologies in the Digital Media (IJEETDM) 1(4):175-181
The Society of Digital Information and Wireless Communications (SDIWC), October - 2015 (ISSN: 2410-0439)

Using a Novel Model to Measure Smart Campus Service Quality: An Empirical Case Study

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ABSTRACT

This study applied a novel model that integrated a service quality model, impact-range performance analysis (IRPA), and impact-asymmetry analysis (IAA) for evaluating product or service features that are crucial parameters for customer satisfaction. This empirical study focused on a Vietnam English teacher training program by using a smart campus solution introduced by Taiwan industries. Service quality improvement suggestions were obtained through the IRPA and IAA results. In the future, the implementation of smart campus solutions can continue to expand in Vietnam and other countries, and additional practical cases can be collected for supporting Taiwan industries in developing innovative services and products.

KEYWORDS

Smart campus, Service quality (SERVQUAL) model, Impact-range performance analysis (IRPA), Impact-asymmetry analysis (IAA)

1 INTRODUCTION

Because of global developments in information and communications technology (ICT), several industries use this technology to develop innovative products or services for a target field or enhance industrial competitiveness by increasing the number of sales channels and integrating cross-cutting industries. According to Decebo report [1], the worldwide e-learning market is expected to grow rapidly and appreciably over the next 3 years. In 2011, the worldwide market for self-paced e-learning products and services reached US$35.6 billion. The 5-year compound annual growth rate is estimated to be approximately 7.6%, and revenues should reach US$51.5 billion by 2016. In addition, the members of the Association of Southeast Asian Nations (ASEAN), which are emerging countries in Asia, are investing 14.7% of their annual budget in education reforms, which include improving school Internet access, the electronic infrastructure, and the teaching and learning environment. Vietnam, India, Indonesia, Singapore, and Malaysia were the first to invest in education. In Vietnam, the Ministry of Education has formulated an education reform policy for the next 37 years (2014–2041); this policy entails a total investment of US$9.92 billion for establishing smart campus settlements in 63 provinces.

The purpose of this study was to integrate and implement smart campus solutions introduced by Taiwan industries in the Dong Nai province, Vietnam, for a K-12 English teacher training program. A novel method that involves integrating the service quality (SERVQUAL) model, impact-range performance analysis (IRPA), and impact-asymmetry analysis (IAA) for measuring service quality on the basis of the perceived satisfaction of service recipients was developed to provide suggestions for service improvements to Taiwan industries and render high-quality adaptive smart campus services.

2 LITERATURE SURVEY

2.1 Smart Campus and Service Quality

The smart campus concept was initially developed at Massachusetts Institute of Technology (MIT) through the MIT–Microsoft Alliance program with the objective of revolutionizing higher education [4]. The Etisalat British Telecom Innovation Centre provided a more complete definition [5-6]. Smart campus has been widely accepted and used in education reform strategies in several Asian countries, and a pilot program and a long-term road map for improving the entire campus learning environment has been proposed. The aforementioned information indicates that promoting intelligent campus learning and providing services have become a major trend in Asian countries. The recent focus on Internet infrastructure, improving the learning environment, and promoting awareness of social, management, health, and green services is based on the specific needs of individuals or a government policy.

In contrast to product quality, service quality refers to a customer's judgement of the performance of a product or a service provided by an industry, organization, or school and is a conscious and intangible attribute that cannot be determined on the basis of appearance. Parasuraman et al. [2] indicated that service quality is more difficult for customers to determine than product quality. In addition, they stated that perceived service quality is the difference between original expectations and actual service performance.

2.2 SERVQUAL Model

Parasuraman et al. [1] proposed a conceptual model for evaluating service quality, the SERVQUAL model. They conducted interviews with management staff and clients in banking, securities, credit card, and product maintenance industries and found that variances and gaps existed between the perceptions of management staff and the services delivered to the clients. They proposed using SERVQUAL measurements to evaluate service quality by reducing 10 original service quality constructs to five constructs (tangibles, reliability, responsiveness, assurance, and empathy). These five constructs provide a clear definition of and are used as measurement variables for service quality.

2.3 Importance–Performance Analysis (IPA)

Martilla and James [11] formulated importance–performance analysis (IPA), and this simple technique has been frequently used for understanding customer satisfaction and prioritizing service quality improvements. IPA has been widely used in several fields, including marketing, logistics, tourism, health care, and education, to improve service quality and facilitate business decision making. In Fig. 1, the X-axis represents the mean of the importance of the service quality dimensions, and the Y-axis represents the mean of the performance. Four quadrants represent different decision making strategies; Quadrant 1 represents "keep up the good work," Quadrant 2 represents "possible overkill," Quadrant 3 represents "low priority," and Quadrant 4 represents "concentrate here."

Numerous studies on the determinants of customer satisfaction have revealed a limitation of IPA; there is a growing evidence that the relationship between attribute-level performance and overall satisfaction with a service can be asymmetric and nonlinear; that is, the "importance" of attributes in creating overall customer satisfaction (OCS) may vary depending on the current level of attribute performance. Therefore, several studies [8-10] have indicated that managerial implications derived from IPA might be misleading.

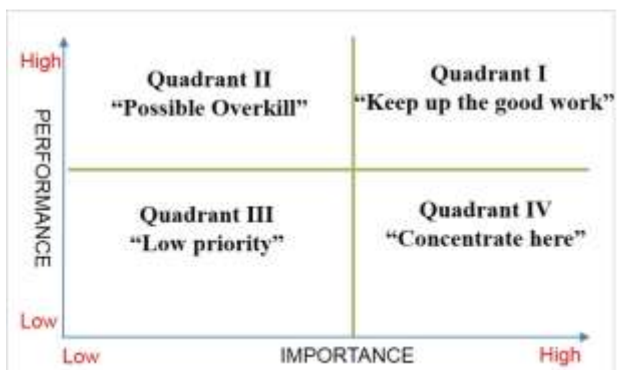

Figure 1. Relationship between importance and performance

3 RESEACH DESIGN AND METHODOLOGY

3.1 Smart Campus Solution Design

In this study, a smart campus solution was proposed for fulfilling the government's objective of upgrading the skills of local K-12 English teachers and improving their teaching quality in the Dong Nai province, Vietnam. The components of the smart campus solution, included trainers, classroom hardware (tablets, projectors, and interactive white boards), a classroom learning management system (eClass), English training materials, and a test system (NewConnection), were designed and integrated. In an empirical case study, the service items were defined and divided into three main function groups and a novel model was used to measure and propose improvement suggestions.

3.2 IRPA and IAA

To overcome the limitation of IPA, Mikulić and Prebežac [8] proposed IRPA and IAA. The first task of IRPA is to solve the asymmetric relationship between service item performance and OCS. In addition, they indicated that service items should be divided into two categories, satisfiers and dissatisfiers, and improving dissatisfiers should be the priority. In IRPA, there are two main decision indices for improvement. The first is the range impact on OCS (RIOCS); this index can show the highest and lowest impact of service items for OCS. The second is the degree of impact asymmetry that quantifies the extent to which a service item has a satisfaction-generating potential (SGP) or a dissatisfaction-generating potential (DGP). Both the SGP and DGP indicate the proportion of reward and penalty indices of the service items to the entire range of scores of the impact on OCS. Furthermore, five regions were divided on the basis of impact asymmetry (IA) indices, and the results were used as the service quality improvement baseline. According to Mikulić and Prebežac [9], the equations are as follows. In the equations, ri is the reward index for service items, pi is the penalty index for service items, and the index regression coefficient was obtained through multi-regression.

$$\mathrm{SGP}_i = r_i/\mathrm{RIOCS}_i \quad (1)$$

$$\mathrm{DGP}_i = p_i/\mathrm{RIOCS}_i \quad (2)$$

$$\mathrm{IA}_i = |\,\mathrm{SGP}_i\,| - |\,\mathrm{DGP}_i\,| \quad (3)$$

$$\mathrm{RIOCS}_i = |\,r_i\,| + |\,p_i\,| \quad (4)$$

$$|\,\mathrm{SGP}_i\,| + |\,\mathrm{DGP}_i\,| = 1 \quad (5)$$

3.3 Implementation

Implementation of this study involved three steps—designing, processing, and analyzing—for determining the service quality that required maintenance or improvement to improve performance and satisfaction. These three steps are described as follows:

3.3.1 Empirical Case Design

The smart campus solution used for the English teacher training program at the Dong Nai University, Vietnam, is defined in Section III A. There were 14 training classes, and all 420 teachers in the program worked in Dong Nai province as English teachers at an elementary school, a junior high school, or a senior high school. The total duration of the training program was 2 months, and training satisfaction was investigated for 1 week by using an integrated model questionnaire.

3.3.2 Questionnaire Design

In the questionnaire design phase, this study focused on the general function, eClass platform, and NewConnection learning system. The SERVQUAL model, which contains five constructs, was used to establish measurement variables for smart classroom service quality. The five constructs and 22 questions in the questionnaires are described as follows:

(1)Tangible service: Such services provided by the smart classroom include tablet quality (Service Item 21: Performance and stability), a Web school (Service Item 6–Service Item 11: Materials, speaking, reading, listening, writing, and comprehensive services), and a system interface (Service Item 17 Providing guidance and assistance to users).

(2)Reliability service items: Such services provided by the smart classroom include overall training (Service Item 22: I think the English teacher training program is effective), an offline app (Service Item 12: Auto-read function can help me read), and a platform (Service Item 16: Makes the teaching process smooth).

(3)Responsiveness service items: This type of service provided by the smart classroom includes teaching attitude (Service Item 4: Interaction between the instructor and you), an offline app (Service Item 14: Repeating the read function can enhance my oral ability), and a quiz (Service Item 18: Remind me to answer correctly when I am given the test).
(4)Assurance service items: This type of service provided by the smart classroom includes professional knowledge (Service Item 1: Curriculum design and richness), teaching skill (Service Item 3: The instructor's teaching skills), an offline app (Service Item 13: The slow read function can train my pronunciation), and statistics (Service Item 19: Know the score and report information).
(5)Empathy service items: Such services provided by a smart classroom include teaching content (Service Item 2 The course content meets your requirements), e-teaching skills (Service Item 5: Your learning is enhanced because of the use of multimedia), an offline app (Service Item 15: App is helpful for reviewing study records after school), and interaction (Service Item 20: Greater opportunity to express myself and interact with the teacher and classmates).

3.3.3 Data Analysis and Suggestions

In the data analysis and suggestion step, 420 questionnaire responses and feedback were collected. Three main function groups and 22 questions were defined using the SERVQUAL model and divided on the basis of the service category. The responses to these 22 questionnaires were analyzed using IRPA and IAA, and the key improvement index was determined. In addition, suggestions were obtained for Taiwan industries, which were the smart campus solution providers.

4 EMPIRICAL CASE RESULT ANALYSIS

This empirical case study focused on smart campus solutions, which were classified into three main (general, NewConnection, and eClass) function groups and used for the English teacher training program at Dong Nai University, Vietnam. These groups are defined in the preceding paragraph, and suggestions for improving performance and satisfaction in the future are described.

4.1 General Function Service Quality

PRCA indices (ri and pi) and the impacts on satisfaction indices (RIOCS, SGP, DGP, and IA) of general function groups are shown in Table I. The results for the general function groups (seven service items) in the impact range-performance analysis (IAA) are shown in Fig. 2. The Y-axis was subdivided into five categories according to the degree of impact asymmetry: delighters ($IAi > 0.8$), satisfiers ($0.8 \geq IAi > 0.2$), hybrids ($0.2 \geq IAi \geq -0.2$), dissatisfiers ($-0.2 > IAi \geq -0.8$), and frustrators ($IAi < -0.8$). In addition, the X-axis was subdivided into three categories according to their RIOCS: high impact ($RIOCSi > 1.15$), medium impact ($0.97 \leq RIOCSi \leq 1.15$), and low impact ($RIOCSi < 1.00$).
On the basis of the general function service quality analysis results of IAA, the priorities for the improvement of service items can be explained. The item with the highest priority was Service Item 5 (enhance your learning through multimedia), indicating that designing more multimedia activities in the learning content can substantially enhance satisfaction. The second most important items were Service Items 2 and 21; thus, increasing the tablet operation stability and learning content diversification can promote learning motivation and effects. The third most important items were Service Items 3 and 4, indicating that the teaching skill and interaction activities of a trainer should be considered in training program design.

Table 1. General functions of importance and performance

Service Items	PRCA		Impact on satisfaction indices			
	RI	*PI*	*RIOCS*	*SGP*	*DGP*	*IA*
1	0.69	-0.47	1.17	0.59	-0.41	0.19
2	0.67	-0.43	1.10	0.61	-0.39	0.22
3	0.70	-0.47	1.17	0.60	-0.40	0.20
4	0.81	-0.33	1.14	0.71	-0.29	0.42
5	0.84	0.00	0.84	1.00	0.00	1.00

21	0.35	-0.75	1.10	0.32	-0.68	-0.37
22	0.64	-0.55	1.19	0.54	-0.46	0.07

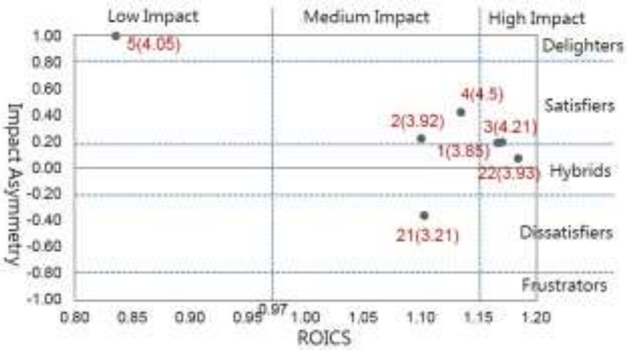

Figure 2. Impact range-performance analysis (IAA) of the general function group

4.2 NewConnection Service Quality Analysis

The PRCA indices (ri and pi) and the impacts on satisfaction indices (RIOCS, SGP, DGP, IA) of the NewConnection function group are shown in Table II. The results for the NewConnection function group (10 service items) in the impact range-performance analysis (IAA) are shown in Fig. 3. The Y-axis was subdivided into five categories according to the degree of impact asymmetry: delighters (IAi > 0.8), satisfiers (0.8 ≥ IAi > 0.2), hybrids (0.2 ≥ IAi ≥ −0.2), dissatisfiers (−0.2 > IAi ≥ −0.8), and frustrators (IAi < −0.8). In addition, the X-axis was subdivided into three categories according to their RIOCS: high impact (RIOCS > 1.16), medium impact (1.00 ≤ RIOCS ≤ 1.16), and low impact (RIOCS < 1.00).

On the basis of the NewConnection function service quality analysis results of IAA, the priorities for the improvement of service items can be explained. The items with the highest priority were Service Items 7, 8, 9, and 12, indicating that increasing listening and speaking training activities in a learning system can positively affect the listening and speaking ability of the trainees. The second most important items were Service Items 21 and 2, suggesting that adding the auto read function can provide more learning opportunities for trainees outside the classroom. The third most important item was Service Item 11, implying that the writing training function can be improved considerably when the other service items are deemed satisfactory.

Table 2. NewConnection functions of importance and performance

Service Items	PRCA		Impact on satisfaction indices			
	RI	*PI*	*RIOCS*	*SGP*	*DGP*	*IA*
6	0.77	-0.30	1.07	0.72	-0.28	0.44
7	0.29	0.00	0.29	1.00	0.00	1.00
8	0.84	0.00	0.84	1.00	0.00	1.00
9	0.85	0.00	0.85	1.00	0.00	1.00
10	0.77	-0.36	1.13	0.68	-0.32	0.37
11	0.66	-0.51	1.16	0.57	-0.43	0.13
12	0.84	0.00	0.84	1.00	0.00	1.00
13	0.80	-0.33	1.13	0.71	-0.29	0.42
14	0.78	-0.31	1.10	0.71	-0.29	0.43
15	0.78	-0.31	1.10	0.72	-0.28	0.43

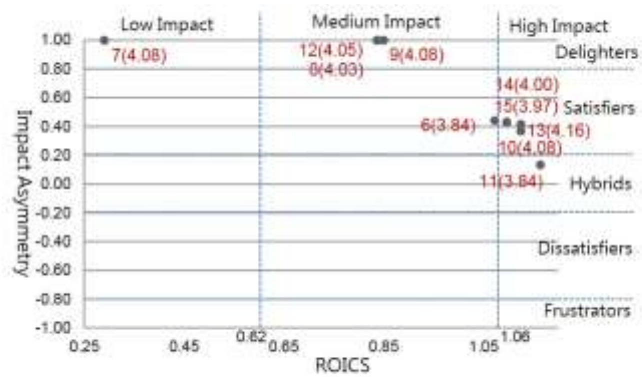

Figure 3. Impact range-performance analysis (IAA) of the NewConnection function group

4.3 eClass Service Quality Analysis

The PRCA indices (ri and pi) and the impacts on satisfaction indices (RIOCS, SGP, DGP, and IA) in the eClass function group are shown in Table III. The results for the eClass function group (five service items) in the impact range-performance analysis (IAA) are shown in Fig. 4. The Y-axis was subdivided into five categories according to the degree of impact asymmetry: delighters (IAi > 0.8), satisfiers (0.8 ≥ IAi > 0.2), hybrids (0.2 ≥ IAi ≥ −0.2), dissatisfiers (−0.2 > IAi ≥ −0.8), and frustrators (IAi < −0.8). In addition, the X-axis was subdivided into three categories according to the RIOCS: high impact (RIOCS > 1.16), medium impact ($1.00 \leq RIOCS \leq 1.16$), and low impact ($RIOCS < 1.00$).

On the basis of the eClass function service quality analysis results of IAA, the priorities for the improvement of service items can be explained. The item with the highest priority was Service Item 19, suggesting that the training score report and analysis function should be redesigned to help trainers interpret the learning or test records of a trainee. The second most important items were Service Items 17 and 18, implying that the guide and support function of eClass should be redesigned to help users find the desired activities. The third most important item was Service Item 20, indicating that the interactive function of eClass performs appropriately and may be improved when the other service items are deemed satisfactory.

Table 3. eClass functions of importance and performance

Service Items	PRCA		Impact on satisfaction indices			
	RI	*PI*	*RIOCS*	*SGP*	*DGP*	*IA*
16	0.71	-0.41	1.13	0.63	-0.37	0.27
17	0.57	-0.63	1.20	0.47	-0.53	-0.05
18	0.68	-0.49	1.18	0.58	-0.42	0.16
19	0.89	0.00	0.89	1.00	0.00	1.00
20	0.74	-0.43	1.16	0.63	-0.37	0.27

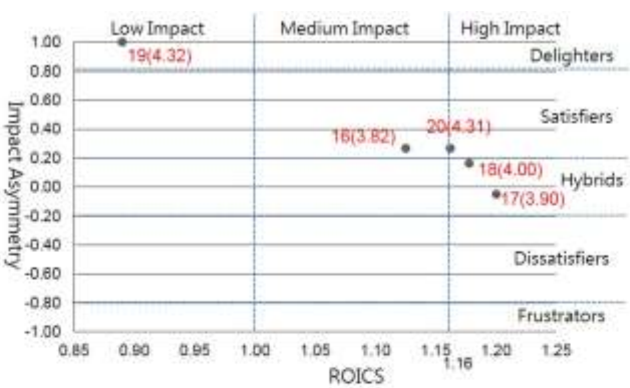

Figure 4. Impact range-performance analysis (IAA) of the eClass function group

5 DISCUSSION

According to the empirical case results of this study, some viewpoints and service improvement suggestions were identified. In the future, on the basis of the results of this study, smart campus-related industries and teaching units could design and implement more effective solutions, enhance satisfaction, and increase the scope of their services. The following inferences were drawn:

Professional trainers and adaptive products and services played a crucial role in this empirical study, and teaching skills and attitude play crucial roles in the training program. In future study, more effort should be expended on the trainer training program, which should be designed to merge local cultural factors to meet the requirements of English teachers in Vietnam. Learning systems should contain more interactive activities to increase knowledge exchange among students and promote learning motivation and effects. In addition, to address the unstable Internet environment in Vietnam, offline activities may be added to online learning services, and a closed loop may be established in classrooms. Furthermore, additional new techniques and innovative service can be implemented in Vietnam.

6 CONCLUSION

This study applied a novel model to measure the perceived quality satisfaction with smart campus solution services during a K-12 English teacher training program in Vietnam. The IRPA and IAA results indicated several suggestions for prioritizing the improvement of service items for smart campus solutions. In the future, this study will be extended to integrate additional smart education technologies with smart campus solutions, such as cross-country collaborative learning and remote or virtual laboratories. Furthermore, more service quality measurement methods will be used and more key improvement suggestions will be provided to enhance the innovative products and services of smart-campus-related industries in Taiwan. The implementation of smart campus solutions can continue in other countries, and additional practical cases can be collected for supporting Taiwan industries in developing innovative services and products.

6 ACKNOWLEDGMENT

The authors thank the Industrial Development Bureau, Ministry of Economic Affairs, Taiwan for funding and supporting this project. This research was supported by the Taiwan e-Learning Industry Cross-Domain Advancement Plan.

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