information

Article

Performance Management Decision-Making Model: Case Study on Foreign Language Learning Curriculums

Kuen-Suan Chen [1,2,3], Chun-Min Yu [1,*], Chun-Hung Yu [4,*] and Yen-Po Chen [5]

[1] Department of Industrial Engineering and Management, National Chin-Yi University of Technology, Taichung 411030, Taiwan; kschen@ncut.edu.tw
[2] Department of Business Administration, Chaoyang University of Technology, Taichung 413310, Taiwan
[3] Department of Business Administration, Asia University, Taichung 413305, Taiwan
[4] Language Center, National Chin-Yi University of Technology, Taichung 411030, Taiwan
[5] School of Philosophy, Psychology and Language Sciences, The University of Edinburgh, Edinburgh EH8 9YL, UK; s2523506@ed.ac.uk
* Correspondence: march@ncut.edu.tw (C.-M.Y.); sylvia@ncut.edu.tw (C.-H.Y.)

Abstract: Foreign language learning courses can be regarded as a service operation system, and a complete foreign language learning course performance evaluation model can help improve the effectiveness of student learning. The performance evaluation matrix (PEM) is an excellent tool for evaluation and resource management decision making, and the administrator uses the satisfaction and the importance indices to establish evaluation coordinate points based on the rules of statistical testing. The coordinate points of all service items are plotted into the PEM to grasp the full picture and to make decisions on what to improve or to consider resource transfers so as to elevate the overall satisfaction of the entire service. However, plotting all the coordinate points on the PEM can only be performed by programming, which will lead to limitations in practice. Therefore, instead of the above evaluation rules, this article uses the confidence intervals of decision-making indicators to form a validity evaluation table, to decide which teaching service items should be improved, maintained, or transferred to improve the satisfaction of the entire service system. This form of performance evaluation can be completed using any commonly used word-processing software, so it is easy to apply and promote. Finally, this article provides an applied example to illustrate the proposed method.

Keywords: performance evaluation matrix; foreign language teaching questionnaire; service operating system; foreign language learning course; statistical inference method

Citation: Chen, K.-S.; Yu, C.-M.; Yu, C.-H.; Chen, Y.-P. Performance Management Decision-Making Model: Case Study on Foreign Language Learning Curriculums. *Information* **2024**, *15*, 481. https://doi.org/10.3390/info15080481

Academic Editor: Maria Carmen Carnero

Received: 22 July 2024
Revised: 9 August 2024
Accepted: 13 August 2024
Published: 14 August 2024

1. Introduction

Several studies have highlighted that globalization has influenced the demand for talent, making foreign language proficiency a critical criterion for recruitment in Taiwan's business circles. Therefore, foreign language learning is increasingly important [1–3]. In the meantime, proficiency in English is also considered a fundamental requirement for admission to well-known universities worldwide. In Taiwan's university entrance examination, English proficiency is one of the key evaluation indicators. Besides English, promoting the learning of a second foreign language has become an important policy for the universities to help students develop a second foreign language skill. Clearly, an effective foreign language course plays a crucial role in developing students' language skills. This enhances not only their learning effect on other academic subjects but also their competitiveness for employment opportunities or further studies. In view of this, a well-rounded decision-making model of performance management for foreign language learning courses was developed to help improve students' foreign language learning performance. Therefore, addressing this matter is of utmost importance.

Many papers are devoted to the study of the performance evaluation matrix (PEM), aiming to assess the performance of various service operations as well as to determine whether they can satisfy the requirements. Moreover, PEM is also used to decide whether to carry out improvements, maintenance, or resource transfers for the satisfaction of service items [4–7]. PEM is a great tool for evaluating and improving service-operating systems [8,9]. This approach, which focuses on the service items provided by the service-operating systems and then designs them into questionnaire scales, can be used to not only investigate customers' or users' satisfaction and importance for each service item but also establishes satisfaction and importance indices. Subsequently, according to the gap between these two indices for each service-operation item, three service quality zones are divided as follows: the service quality-improvement zone, the service quality-maintenance zone, and the resource-transfer zone [10]. Also, several studies have utilized confidence intervals to generate evaluation coordinate points for the satisfaction index and the importance index of each service item. This allows for an observation of the service quality zones within the PEM framework where the evaluation coordinate points for all service items lie. Consequently, decisions can be made regarding which service items require improvements or resource transfers [11].

The foreign language learning course can also be seen as a service-operating system. As mentioned above, developing a sound model of performance evaluation and resource management decision making for foreign language learning courses is an essential issue. Additionally, PEM is a great tool that is applicable to evaluation and resource management. Hence, this paper designs a teaching questionnaire using the service items which the foreign language learning courses provide to investigate students' (customers') satisfaction and importance for each teaching service item. According to many scholars' viewpoints, indices are simple and unitless management tools, and they are convenient for management and communication [12]. Consequently, this paper defines the importance index, the satisfaction index, and the decision index. Nevertheless, plotting all the evaluation coordinate points into the PEM cannot be completed without programming, resulting in limitations in real practice. Therefore, this paper employs the confidence intervals of decision indices to establish a performance evaluation table (PET) to replace the PEM. This PET is built on statistical testing rules of the confidence intervals of decision indices. Accordingly, it can be used to decide on which teaching service items we should carry out improvements, maintenance, or resource transfers on to lift the satisfaction of the entire service system. To increase the improvement efficiency, the values of the decision indices can be directly used to determine the priority for making improvements when multiple teaching service items need enhancements with limited resources. As mentioned above, this approach uses the PET to solve this research gap and has advantages. In addition, regarding the questionnaire design of teaching service items, this paper adopts Yu et al.'s questionnaire involving the foreign language teaching satisfaction [13], with reference to the research of Yeh et al. [14].

The remaining sections are structured as follows. In the next section, we provide a literature review on related research studies. In Section 3, we propose research methods, including the establishment of indices involving satisfaction, importance, and decision, and then we derive confidence intervals of the decision index. Next, statistical testing is performed based on the confidence intervals. Afterward, a PET is built based on the statistical testing rules. Therefore, we can determine whether all teaching service items should conduct improvements, maintenance, or resource transfers to raise the satisfaction of the entire service system. Subsequently, in Section 4, we present an applied example illustrating the applicability of the proposed approach. Lastly, conclusions are provided in Section 5.

2. Literature Review

As mentioned above, the theme of this paper is the application of the PEM to a model of performance evaluation and resource management decision making for foreign language learning courses. This model is built on the service items that foreign language

learning courses provide and later designs them into a questionnaire to investigate students' (customers') satisfaction and importance for each teaching service item. The research methods include setting the satisfaction index and the importance index, establishing a PEM using these two indices, and defining three service quality zones. Additionally, the decision index is defined, and the confidence interval of the index is derived. Then, the confidence interval is employed to carry out statistical testing, in order to decide whether all teaching service items should conduct improvements, maintenance, or resource transfers. When multiple teaching service items require improvements with limited resources, the decision index can directly determine the priority of improvement. As the value of the decision index is negative, the satisfaction is lower than the importance. Consequently, the priority of its improvement should be higher. Based on the above, this paper carries out a literature review on the questionnaire scales, the setting of the performance evaluation matrices and indicators, and statistical testing.

2.1. Questionnaire and PEM

Lambert and Sharma [15] built a PEM based on the seven scales of the designed questionnaire, setting satisfaction as the x-coordinate and importance as the y-coordinate, respectively. Among the seven scales, satisfaction and importance are divided into three equal parts using scales 1, 3, 5, and 7, respectively, and the PEM is divided into 9 squares. The three squares in the upper-left corner have higher importance than satisfaction. The items falling in these three squares indicate that customer importance is high, whereas satisfaction is low, so they must be improved. For the items situated in the three diagonal squares in the middle, since customers attach equal importance and satisfaction to them, they only need to maintain the current level of satisfaction. The three squares in the lower-right corner indicate that customer importance is not high, but satisfaction is high for the items. Therefore, it is necessary to examine the items and see whether they need to transfer resources to lift the overall satisfaction. Huang et al. [16] assumed that the distributions of customer satisfaction and customer importance were both subject to the BETA distribution, proposed that the index values of satisfaction and importance are between zero and one, and modified the above 9-square indices to perfect them. Then, Yu et al. [17] came up with a PEM with fuzzy semantics, encouraged the continuous improvement of comprehensive quality management to define the service quality zones, and made evaluation criteria at the same time. Many scholars have invested in research on the performance evaluation matrix to make it more complete [18–20]. Furthermore, several studies have applied the method of PEM to assess operational performance for various service-operating systems, aiming to enhance their overall performance. These service-operating systems include satisfaction with banking services [4], satisfaction with the service operations of various APPs [11], etc.

2.2. Index Setting and Statistical Testing

According to numerous studies, indices are standardized and unitless [12]. Whether indices are good or bad can be directly evaluated by their values without using tolerances or specifications. Therefore, they are simple and convenient management tools [21,22]. Since indices have unknown parameters, misjudgments may be caused by sampling errors, if the indices are directly evaluated by their point estimates [23]. Quite a few studies have adopted sample data to derive confidence intervals of indices and have used confidence intervals of indices to establish statistical testing rules for service operation performance indices [24–26]. Additionally, some studies have also employed confidence intervals of indices to set up the evaluation coordinate points of the satisfaction index and the importance index for each service item and have observed the positions of the evaluation coordinate points for all service items in the PEM, aiming to decide which service items need to perform improvements or resource transfers [10]. When the Internet of Things (IoT) becomes more and more popular and big data analysis technology matures, enterprises pursue quick responses to better their decision-making performance [27,28].

3. Research Methods

As mentioned earlier, this article uses the service items provided by foreign language learning courses to design a teaching questionnaire scale to investigate students' satisfaction and importance of each teaching service item. An additional goal of this study is to establish a foreign language teaching performance evaluation scale based on the trust intervals of all important decision-making indicators of services and to decide which teaching service items need to be improved, maintained, or resource transferred to improve the satisfaction of the entire service system. The questionnaire content of this paper would reflect the services provided by foreign language teaching with the following five dimensions: 1. teaching preparation, 2. attitude towards teaching, 3. teaching capability, 4. teaching management, and 5. coursework and evaluation. Each dimension contains several service items that need to be investigated. Aiming to retain generality, we assumed that there were q service items that should be investigated, and the r-scale was used to conduct the survey. Moreover, each service item included two questions involving importance and satisfaction, so a total of $2q$ questions should be answered in the entire questionnaire [11,17]. Similar to some other papers, this paper used a random variable Y_j to represent the importance of a teaching service item j and a random variable X_j to represent the satisfaction of a service item j [17]. Let μ_{Yj} be the expected value of the random variable Y_j and μ_{Xj} be the expected value of the random variable X_j. Then, we define the importance index I_j and the satisfaction index S_j, respectively, as follows:

$$\text{Importance index } I_j = \frac{\mu_{Yj} - 1}{R} \tag{1}$$

and

$$\text{Satisfaction index } S_j = \frac{\mu_{Xj} - 1}{R} \tag{2}$$

where $R = k - 1$. Obviously, $0 \le I_j, S_j \le 1$, and $j = 1,\ldots, q$. According to some studies, this paper sets the satisfaction index S_j as the x-coordinate and the importance index as the y-coordinate to build a PEM for foreign language teaching as follows. At the same time, the PEM was divided into three service quality zones: the service quality-improvement zone Z_I, the service quality-maintenance zone Z_M, and the resource-transfer zone Z_T, defined as follows:

$$\text{Zone } Z_I = \left\{ (S_j, I_j) \middle| 0.18 \le I_j - S_j, 0 \le S_j, I_j \le 1 \right\}$$

$$\text{Zone } Z_M = \left\{ (S_j, I_j) \middle| -0.18 < I_j - S_j < 0.18, 0 \le S_j, I_j \le 1 \right\}$$

$$\text{Zone } Z_T = \left\{ (S_j, I_j) \middle| I_j - S_j \le -0.18, 0 \le S_j, I_j \le 1 \right\}$$

In the performance evaluation matrix for foreign language teaching, Zone Z_I, Zone Z_M, and Zone Z_T are displayed in Figure 1, as follows:

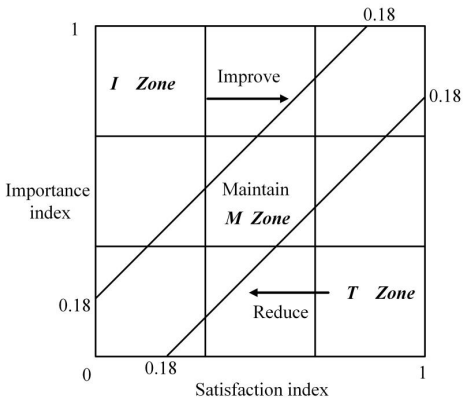

Figure 1. Performance evaluation matrix for foreign language teaching.

Let the random variable $D_j = Y_j - X_j$ be a decision variable for the teaching service item j. Then, the expected value of the random variable D_j is denoted by $\mu_{Dj} = \mu_{Yj} - \mu_{Xj}$. Obviously, when $Y_j = X_j$, then the expected value of the random variable D_j is $\mu_{Dj} = \mu_{Yj} - \mu_{Xj} = 0$. Thus, the importance of the teaching service item j is equivalent to the satisfaction. Based on Hung et al. [16], the satisfaction of the teaching service item j just needs to be maintained. When $Y_j > X_j$, then the expected value of the random variable D_j is denoted by $\mu_{Dj} = \mu_{Yj} - \mu_{Xj} > 0$. At this moment, the importance of the teaching service item j is higher than its satisfaction. Hung et al. [16] noted that the teaching service item j needs to be improved, as the importance of the teaching service item j is higher than its satisfaction. Similarly, when $Y_j < X_j$, then, the expected value of the random variable D_j represents $\mu_{Dj} = \mu_{Yj} - \mu_{Xj} < 0$. At this time, the importance of the teaching service item j is lower than its satisfaction, indicating that the customer is highly satisfied with the teaching service item j but is not that attentive to it. Therefore, we only need to carry out maintenance or resource transfers to level up the satisfaction of the entire service system. Based on the above, the decision index θ_j is defined as follows:

$$\theta_j = \frac{\mu_{Dj}}{R} = \frac{\mu_{Yj} - \mu_{Xj}}{R} = I_j - S_j \tag{3}$$

Obviously, when the value of the decision index θ_j is between -0.18 and 0.18, and $Y_j = X_j$, then we have $-0.18 \leq I_j - S_j \leq 0.18$. Thus, the coordinate point of the teaching service item j belongs to Z_M, that is $(I_j, S_j) \in Z_M$. When the value of the decision index θ_j is bigger than 0.18, then we have $I_j - S_j > 0.18$. Thus, the coordinate point of the teaching service item j belongs to Z_I, that is $(I_j, S_j) \in Z_I$. When the value of the decision index θ_j is smaller than -0.18, then we have $I_j - S_j < -0.18$. Thus, the coordinate point of the teaching service item j belongs to Z_T, that is $(I_j, S_j) \in Z_T$. To sum up, this paper can use the value of the decision index θ_j to replace the PEM as the decision-making model for evaluating and improving the teaching performance of foreign language learning courses. To reduce the possibility of misjudgment due to sampling errors, we employed statistical testing rules to establish evaluation rules. The hypotheses of statistical testing for the decision index θ_j are listed below:

null hypothesis H_0: $-0.18 \leq \theta_j \leq 0.18$

alternative hypothesis H_1: $\theta_j < -0.18$ or $\theta_j > 0.18$

Based on some other studies, the questionnaire surveys were all conducted using random sampling. Let $\left(X_{j1}, \ldots, X_{jl}, \ldots, X_{jn}\right)$ be a group of the random samples of teaching satisfaction and $\left(Y_{j1}, \ldots, Y_{jl}, \ldots, Y_{jn}\right)$ be a group of the random samples of teaching importance. Then, let $\left(D_{j1}, \ldots, D_{jl}, \ldots, D_{jn}\right)$ be a group of the random samples of the random variable D_j, where $D_{jl} = Y_{jl} - X_{jl}$, l = 1, 2, …, n, and j = 1, 2, …, q. Thus, the sample mean and sample standard deviation are expressed as follows:

$$\overline{D}_j = \frac{1}{n} \times \sum_{l=1}^{n} D_{jl} \tag{4}$$

and

$$S_{Dj} = \sqrt{\frac{1}{n-1} \times \sum_{l=1}^{n} \left(D_{jl} - \overline{D}_j\right)^2} \tag{5}$$

Thus, the estimator of the decision index θ_j is denoted as follows:

$$\hat{\theta}_j = \frac{\overline{D}_j}{R} \tag{6}$$

The expected value and the standard deviation for the estimator of the decision index θ_j are defined as follows:

$$E\left[\hat{\theta}_j\right] = \frac{E\left[\overline{D}_j\right]}{R} = \frac{\mu_{Dj}}{R} = \theta_j \tag{7}$$

$$SD\left[\hat{\theta}_j\right] = \sqrt{Var\left[\hat{\theta}_j\right]} = \sqrt{\frac{Var\left[\overline{D}_j\right]}{R^2}} = \frac{\sigma_{Dj}}{\sqrt{n}R} \tag{8}$$

where σ_{Dj} is the standard deviation of the random variable D_j. Also, the random variable Z_j is expressed below:

$$Z_j = \frac{\hat{\theta}_j - \theta_j}{S_{Dj}/\sqrt{n}R} \tag{9}$$

Based on the Central Limits Theorem, the distribution of the random variable Z_j approximates the standard normal distribution, denoted by $Z_j \approx N(0,1)$ [26]. Adhering to the above principle, this paper derived the $100(1-\alpha)\%$ confidence interval of the decision index θ_j below:

$$\begin{aligned} 1-\alpha &= p\left(-z_{\alpha/2} \le Z_j \le z_{\alpha/2}\right) \\ &= p\left(-z_{\alpha/2} \le \frac{\hat{\theta}_j - \theta_j}{S_{Dj}/\sqrt{n}R} \le z_{\alpha/2}\right) \\ &= p\left(\hat{\theta}_j - z_{\alpha/2}\frac{S_{Dj}}{\sqrt{n}R} \le \theta_j \le \hat{\theta}_j + z_{\alpha/2}\frac{S_{Dj}}{\sqrt{n}R}\right) \end{aligned} \tag{10}$$

where z_α denotes the upper α quantile of the standard normal distribution. Therefore, $\left[L\theta_j,\ U\theta_j\right]$ represents the $100(1-\alpha)\%$ confidence interval of the decision index θ_j as follows:

$$L\theta_j = \hat{\theta}_j - z_{\alpha/2}\frac{S_{\theta j}}{\sqrt{n}} \tag{11}$$

$$U\theta_j = \hat{\theta}_j + z_{\alpha/2}\frac{S_{\theta j}}{\sqrt{n}} \tag{12}$$

where $S_{\theta j} = S_{Dj}/R$. Then, we adopted the $100(1-\alpha)\%$ confidence interval of the decision index θ_j to establish the testing rules as follows:

(1) If $\left[L\theta_j,\ U\theta_j\right] \cap [-0.18, 0.18] \neq \phi$, then do not reject H_0 and conclude that $\left(I_j, S_j\right) \in Z_M$. Thus, the satisfaction of the teaching service item j does not require any improvement.
(2) If $L\theta_j > 0.18$, then reject H_0 and conclude that $\left(I_j, S_j\right) \in Z_I$. Thus, the satisfaction of the teaching service item j needs to make some improvement.
(3) If $U\theta_j < -0.18$, then reject H_0 and conclude that $\left(I_j, S_j\right) \in Z_T$. Thus, the satisfaction of the teaching service item j only needs maintenance or resource transfers to boost the satisfaction of the entire service system.

Following the above statistical testing decision-making rules, a foreign language teaching PET is built, as shown in Table 1:

Table 1. Foreign language teaching PET.

Dimension	Item j	$\hat{\theta}_j$	$L\theta_j$	$U\theta_j$	Zone
Dimension 1: teaching preparation	1	$\hat{\theta}_1$	$L\theta_1$	$U\theta_1$	Z_1
	2	$\hat{\theta}_2$	$L\theta_2$	$U\theta_2$	Z_2
	⋮	⋮	⋮	⋮	⋮
	q_1	$\hat{\theta}_{q_1}$	$L\theta_{q_1}$	$U\theta_{q_1}$	Z_{q_1}

Table 1. *Cont.*

Dimension	Item j	$\hat{\theta}_j$	$L\theta_j$	$U\theta_j$	Zone
⋮	⋮	⋮	⋮	⋮	⋮
⋮	j	$\hat{\theta}_j$	$L\theta_j$	$U\theta_j$	Z_j
⋮	⋮	⋮	⋮	⋮	⋮
Dimension 5: coursework and evaluation	⋮	⋮	⋮	⋮	⋮
	q_5	$\hat{\theta}_{q_5}$	$L\theta_{q_5}$	$U\theta_{q_5}$	Z_{q_5}

In Table 1, we have $q_1 + q_2 + q_3 + q_4 + q_5 = q$, and then, the decision-making rules are made as follows:

(1) When $Z_j = Z_I$, then the satisfaction of the teaching service item j requires improvement.
(2) When $Z_j = Z_M$, then the satisfaction of the teaching service item j does not require any improvement.
(3) When $Z_j = Z_T$, then the satisfaction of the teaching service item j only requires maintenance or a resource transfer to satisfy the entire service system.

4. An Applied Example

As mentioned earlier, we utilized Yu et al.'s foreign language teaching satisfaction questionnaire [13], which comprises five dimensions reflecting the services offered by foreign language teaching courses. Dimension 1, teaching preparation, contains 4 items, such as "The quantity of the material is appropriate". Dimension 2, attitude towards teaching, includes 5 items, such as "Teachers value the opinions of students". Dimension 3, teaching capability, has 2 items, such as "Teachers speak foreign languages clearly". Dimension 4, teaching management, contains 3 items, such as "Teachers use a variety of teaching methods". Finally, dimension 5, coursework and evaluation, contains 2 items, such as "Evaluation is at an adequate level of complexity". These five dimensions comprise 16 question items in total, and each has two sub-questions involving importance and satisfaction. Accordingly, a total of $2q$ questions in the entire questionnaire need answers.

As mentioned above, the operating performance of foreign language teaching courses is the basis for students who intend to level up their foreign language proficiency. Furthermore, foreign language proficiency is often one of the key indices for recruitment opportunities in the business world. Not only can it help students improve their learning efficiency in other academic subjects, but it can also enhance their competitiveness for further studies or employment opportunities. Accordingly, foreign language teaching courses are prioritized in teaching-enhancement plans by numerous universities. Regarding the above-mentioned foreign language teaching satisfaction questionnaire consisting of 16 questions, students in the case-study school were given a total of 415 copies and were requested to return them, of which 362 copies were collected, yielding a response rate of 87.2%.

Then, the values of the relevant sample statistics for all the service items were obtained, as displayed in Table 2:

Table 2. Foreign language teaching performance evaluation table with q = 16 and n = 362.

Dimension	Item	$\hat{\theta}_j$	$L\theta_j$	$U\theta_j$	Zone
Dimension 1	1	0.18	0.16	0.20	Z_M
	2	0.06	0.04	0.08	Z_M
	3	0.12	0.10	0.14	Z_M
	4	0.19	0.18	0.20	Z_M

Table 2. *Cont.*

Dimension	Item	$\hat{\theta}_j$	$L\theta_j$	$U\theta_j$	Zone
Dimension 2	5	0.09	0.07	0.11	Z_M
	6	0.37	0.35	0.39	Z_I
	7	−0.38	−0.39	−0.37	Z_T
	8	0.23	0.21	0.25	Z_I
	9	−0.01	−0.03	0.01	Z_M
Dimension 3	10	0.02	0.00	0.04	Z_M
	11	0.05	0.03	0.07	Z_M
Dimension 4	12	−0.45	−0.46	−0.44	Z_T
	13	0.09	0.07	0.11	Z_M
	14	0.21	0.19	0.23	Z_I
Dimension 5	15	0.01	−0.01	0.03	Z_M
	16	−0.02	−0.04	0.00	Z_M

According to the above foreign language teaching PET, the teaching service items that need improvements include "Teachers value students' opinions" (item 6), "Teachers are pleased to help students solve problems" (item 8) and "Teachers adequately control the pace of learning" (item 14). The teaching service items that need to take maintenance or resource transfers into account include the following: "Student-teacher interaction in class is strong" (item 7) and "Teachers use a variety of teaching methods" (item 12).

Based on the above cases, the following can be stated of the PET mentioned in this article:

(1) The PET retains the advantages of the PEM being simple and easy to apply, and decisions can be made by the notes in the table. At the same time, you do not have to worry about the complexities and limitations of the PEM that must be drawn with the software.
(2) The PET still conducts statistical testing based on confidence intervals to reduce the risk of misjudgments due to sampling errors.
(3) In addition to being used to evaluate the performance of teaching systems, this model can also be applied to various service-operating systems, such as bus APPs, shopping website APPs, etc.

5. Conclusions

Enhancing the foreign language learning performance will contribute to boosting students' foreign language proficiency. Not only can it help students level up the effectiveness of learning other academic subjects, but it can also raise their competitiveness for further studies or employment opportunities. Although the PEM can simultaneously gauge all of the service items for foreign language learning courses, its disadvantage is that the evaluation requires the support of programming software. Consequently, this paper defined the decision index based on the gap between the importance and the satisfaction indices for each teaching service item. Next, we derived a confidence interval of the decision index and performed statistical testing based on this confidence interval. This statistical testing rule retains the spirit and advantage of the decision-making rule by evaluating the coordinate points falling into the service quality zone and facilitates the decision making of administrators on whether to carry out improvements, maintenance, or resource transfers for the satisfaction of each teaching service item. Considering the confidence interval of the decision index required by the above-mentioned statistical testing rule, this paper developed a foreign language teaching PET to substitute for the foreign language teaching PEM. In fact, a performance evaluation table can be completed through word-processing software only, which is very conducive to applications and promotions. In addition, in order to boost the improvement efficiency, or when resources are limited, multiple teaching service items that need enhancements with limited resources can directly

prioritize improvements based on the value of the decision index. Moreover, regarding the questionnaire design of the teaching service items, the content of the foreign language teaching course satisfaction questionnaire in this paper was divided into five dimensions. These five dimensions were employed to evaluate the services offered by foreign language learning courses. The results demonstrate that the 6th, 8th, and 14th teaching service items of dimension 2 and dimension 4 fall into Z_I, indicating that they need to be listed in the improvement items. Finally, this paper presented an applied example illustrating the applicability of the proposed approach.

The questionnaire in this article is designed as a K scale, which follows a multinomial distribution. It is relatively difficult and complex to make statistical inferences. A relatively large sample size is necessary to make statistical inferences by the central set limits theorem. Therefore, this study is limited to a large sample size. However, when companies pursue rapid responses and cost considerations, the sample size is usually not too large to make decisions. Future research is, therefore, recommended to consider how to develop appropriate decisions with a small sample size.

Author Contributions: Conceptualization, K.-S.C. and C.-M.Y.; methodology, K.-S.C. and C.-M.Y.; software, C.-H.Y.; validation, C.-H.Y.; formal analysis, K.-S.C. and C.-M.Y.; resources, C.-H.Y.; data curation, Y.-P.C.; writing—original draft preparation, K.-S.C., C.-M.Y., C.-H.Y. and Y.-P.C.; writing—review and editing, K.-S.C. and C.-M.Y.; visualization, Y.-P.C.; supervision, K.-S.C.; project administration, C.-M.Y.; All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Informed Consent Statement: Not applicable.

Data Availability Statement: The original contributions presented in this study are included in the article, and further inquiries can be directed to the corresponding authors.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Li, R. Research trends of blended language learning: A bibliometric synthesis of SSCI-indexed journal articles during 2000–2019. *ReCALL* **2022**, *34*, 309–326. [CrossRef]
2. Li, X.; Huang, X. Improvement and Optimization Method of College English Teaching Level Based on Convolutional Neural Network Model in an Embedded Systems Context. *Comput. Aided Des. Appl.* **2024**, *21*, 212–227. [CrossRef]
3. Graham, K.M.; Yeh, Y.F. Teachers' implementation of bilingual education in Taiwan: Challenges and arrangements. *Asia Pac. Educ. Rev.* **2023**, *24*, 461–472. [CrossRef]
4. Chen, S.H. Establishment of a Performance-Evaluation Model for Service Quality in the Banking Industry. *Serv. Ind. J.* **2009**, *29*, 235–247. [CrossRef]
5. Marković, S.; Janković, S.R. Exploring the relationship between service quality and customer satisfaction in croatian hotel industry. *Tour. Hosp. Manag.-Croat.* **2013**, *19*, 149–164. [CrossRef]
6. Yang, C.C. Establishment and applications of the integrated model of service quality measurement. *Manag. Serv. Qual.* **2003**, *13*, 310–324. [CrossRef]
7. Wong, R.C.P.; Szeto, W.Y. An alternative methodology for evaluating the service quality of urban taxis. *Transp. Policy* **2018**, *69*, 132–140. [CrossRef]
8. Martínez-Caro, E.; Cegarra-Navarro, J.G.; Cepeda-Carrión, G. An application of the performance-evaluation model for e-learning quality in higher education. *Total Qual. Manag. Bus. Excell.* **2015**, *26*, 632–647. [CrossRef]
9. Mustafa, H.; Omar, B.; Mukhiar, S.N.S. Measuring destination competitiveness: An importance-performance analysis (IPA) of six top island destinations in South East Asia. *Asia Pac. J. Tour. Res.* **2020**, *25*, 223–243. [CrossRef]
10. Pai, F.Y.; Yeh, T.M. Effective implementation for introducing ISO/TS 16949 in semiconductor manufacturing industries, Total Qual. *Manag. Bus. Excell.* **2013**, *24*, 462–478. [CrossRef]
11. Jeng, M.Y.; Yeh, T.M.; Pai, F.Y. A Performance Evaluation Matrix for Measuring the Life Satisfaction of Older Adults Using eHealth Wearables. *Healthcare* **2022**, *10*, 605. [CrossRef]
12. Kucukaltan, B.; Irani, Z.; Aktas, E. A decision support model for identification and prioritization of key performance indicators in the logistics industry. *Comput. Hum. Behav.* **2016**, *65*, 346–358. [CrossRef]
13. Yu, C.M.; Chang, H.T.; Hsu, S.Y. An assessment of quality and quantity for foreign language training course to enhance students' learning effectiveness. *Int. J. Inf. Manag. Sci.* **2017**, *28*, 53–66.

14. Yeh, L.C.; Tung, C.C.; Yang, S.Y.; Chen, J.H.; Shiau, F.H. The Development of the University Teacher Instructional Evaluation Scale. *Psychol. Test.* **2005**, *52*, 59–82.
15. Lambert, D.M.; Sharma, A. A customer-based competitive analysis for logistics decisions. *Int. J. Phys. Distrib. Logist. Manag.* **1990**, *20*, 17–24. [CrossRef]
16. Hung, Y.H.; Huang, M.L.; Chen, K.S. Service Quality Evaluation by Service Quality Performance Matrix. *Total Qual. Manag. Bus. Excell.* **2003**, *14*, 79–89. [CrossRef]
17. Yu, C.M.; Chang, H.T.; Chen, K.S. Developing a performance evaluation matrix to enhance the learner satisfaction of an e-learning system. *Total Qual. Manag. Bus. Excell.* **2018**, *29*, 727–745. [CrossRef]
18. Li, Y.; Wang, L.; Li, F. A data-driven prediction approach for sports team performance and its application to national basketball association. *Omega* **2021**, *98*, 102123. [CrossRef]
19. Nam, S.; Lee, H.C. A text analytics-based importance performance analysis and its application to airline service. *Sustainability* **2019**, *11*, 6153. [CrossRef]
20. Wu, J.; Wang, Y.; Zhang, R.; Cai, J. An approach to discovering product/service improvement priorities: Using dynamic importance-performance analysis. *Sustainability* **2018**, *10*, 3564. [CrossRef]
21. Gutierrez, D.M.; Scavarda, L.F.; Fiorencio, L.; Martins, R.A. Evolution of the performance measurement system in the logistics department of a broadcasting company: An a.ction research. *Int. J. Prod. Econ.* **2015**, *160*, 1–12. [CrossRef]
22. Rodriguez, R.R.; Saiz, J.J.A.; Bas, A.O. Quantitative relationships between key performance indicators for supporting decision-making processes. *Comput. Ind.* **2009**, *60*, 104–113. [CrossRef]
23. Cheng, S.W. Practical implementation of the process capability indices. *Qual. Eng.* **1994**, *7*, 239–259. [CrossRef]
24. Xu, Y.; Zhang, X.; Meng, P. A novel intelligent deep learning-based uncertainty-guided network training in market price. *IEEE Trans. Ind. Inform.* **2022**, *18*, 5705–5711. [CrossRef]
25. Chen, H.Y.; Lin, K.P. Fuzzy supplier selection model based on lifetime performance index. *Expert Syst. Appl.* **2022**, *208*, 118135. [CrossRef]
26. Durmuş, V. Does the healthcare decentralization provide better public health security capacity and health services satisfaction? An analysis of OECD countries. *J. Health Organ. Manag.* **2024**, *38*, 209–226. [CrossRef]
27. Syafrudin, M.; Alfian, G.; Fitriyani, N.L.; Rhee, J. Performance analysis of IoT-based sensor, big data processing, and machine learning model for real-time monitoring system in automotive manufacturing. *Sensors* **2018**, *18*, 2946. [CrossRef]
28. Gopalakrishnan, S.; Kumaran, M.S. Iiot framework based ml model to improve automobile industry product. *Intell. Autom. Soft Comput.* **2022**, *31*, 1435–1449. [CrossRef]