An Empirical Study of Higher Vocational English Learning Efficiency Based on DEA Model

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Abstract. The evaluation of learning efficiency is an important part of teaching work. However, traditional evaluation methods mainly focus on learning results and ignore the input factors of students. In view of this, this paper considers the relationship between input and output of learning and constructs DEA model to study the efficiency of English learning in higher vocational colleges. The model is applied to evaluate the learning efficiency of five students in a higher vocational college in Yunnan Province. The results show that 75% of the students have low comprehensive learning efficiency in preparing for the AB-level exam. The main reason is that the input of training time and resource use is not optimized. At the same time, the learning efficiency evaluation method based on DEA model is effective, and this model can become an important tool for teachers to improve teaching quality.

Keywords: Higher vocational English · Learning efficiency · DEA projection analysis

1 Introduction

Scientific evaluation of students' English learning efficiency has been a key topic in the field of foreign languages for decades. To judge whether students' English learning is effective, it is too one-sided to evaluate only the test results. Although in recent years Our universities will also learn procedural examination (student's class attendance, homework completion quality, performance, etc.) into the standard grades, but developed in today's society, the network process such as grade examination may not be able to objectively reflect the students' study effect, or more traditional learning to evaluate students' final examination results. According to Yuan Yingying, the weighted calculation method of combining usual grades with final grades is adopted in the learning evaluation of a certain course, which does not take into account the individual differences of each student. It is unreasonable for both students and teachers to adopt unified examination standards to evaluate the learning effect of the course for students with different learning foundations [1, 2]. At the same time, this assessment standard cannot compare the learning efficiency of students with the same final score, ignores some dynamic input factors in the learning process (such as learning time, etc.), and cannot give comprehensive evaluation of learning.

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At present, domestic scholars mainly focus on qualitative analysis of learning efficiency, and often analyses the current situation of students' course learning based on the teaching experience of teachers. The optimization model of learning efficiency constructed through subjective judgment research has little support in the implementation process. Students' learning process can be viewed from the perspective of economics. Every economic activity is through large and small social decisions, input certain production factors to get the corresponding economic output. DEA model is a relative efficiency evaluation method commonly used in economic research, which is a quantitative analysis of multi-factor input-output ratio. We can regard the learning process of students as an economic activity with multiple inputs and outputs, so as to objectively evaluate the learning efficiency of students by using DEA model [3]. Therefore, the concept of input-output ratio of economics will be introduced through the data envelopment analysis method (DEA) to evaluate the learning process of higher vocational English for students majoring in surveying and mapping technology of a vocational college in Yunnan Province, aiming to solve the following problems: (1) How efficient is the relative efficiency of their university English learning for students with different AB level test scores? (2) Through DEA's projection tool, find out the main reasons for the lack of efficiency in students' college English learning.

2 Model Construction

After one year of learning, the improvement of English ability and the internal motivation of learning are also considered as English learning output. The author uses the data envelopment analysis (DEA) model selection of the university entrance exam of English, effective listening time, learning English (listening, speaking, reading and writing training duration), English learning resource usage, AB grade exam scores, increase their ability to learn, learning happiness index (intrinsic motivation), multiple indicators, A questionnaire survey was conducted on the English learning efficiency of higher vocational colleges among 720 students majoring in surveying and mapping technology of grade 2021 in a higher vocational college in Yunnan. The principle of DEA model is to compare all the participants (decision making units) in the same economic activity with the optimal producers, and quantify the efficiency gap between them [4–6].

2.1 Model Indicators

According to the characteristics of higher vocational English learning, the input and output indicators selected in this paper are shown in Table 1.

2.2 Experimental Data

According to the determined input and output indicators of higher vocational English learning, this paper distributed relevant questionnaires to 720 students majoring in surveying and mapping technology of grade 2021 in a higher vocational college in Yunnan Province, and processed the recovered learning data. Firstly, the data of students with zero AB test scores and abnormal weekly average after-class training time were deleted.

Table 1. Input and output index system of college English learning efficiency

	Indicators category	Instructions
Input indicators	X1 Students' Gaokao English scores	The full score is 150 points
	X2 Valid class time	A total of 120 class hours in 2 semesters
	X3 Training time after listening class	Weekly average time, 2 semesters 40 weeks
	X4 Reading out of class training time	Weekly average time, 2 semesters 40 weeks
	X5 Training time after writing and translation class	Average weekly time, 2 semesters, 40 weeks
	X6 Extracurricular resource use	Questionnaire scale
Output indicators	Y1 AB level listening score	The transcript
	Y2 AB level exam reading results	The transcript
	Y3 AB level exam translated as written	The transcript
	Y4 Improvement in English ability	Questionnaire scale
	Y5 Internal motivation for English learning	Questionnaire scale

Then, the total effective listening time (X2) and the total after-class training time of listening (X3), reading (X4), writing and translation (X5) of each student in two semesters were calculated, and 58 valid data samples were obtained. Descriptive statistical analysis of the sample data was carried out by using the software R Language, and the specific results are shown in Table 2.

As can be seen from the skewness and kurtosis, all the sample data basically present a normal distribution. In terms of the input index of College Entrance Examination English score (X1), the highest score is 110, the lowest score is 32, and the mean value is near the pass line. It can be seen that the students' English entrance foundation is weak on the whole, and the learning achievement gap is large. There are 120 class hours in college English courses in the second semester, and each class lasts for 40 min (0.67 h). The total effective listening time of students is 94 h on average, accounting for 78% of the class time, indicating that students' listening effect is not ideal and their attention is not enough in class. For after-class practice time (X3-X5), it is not difficult to find that these three groups of data have the largest fluctuation, and students' self-awareness is very different.

2.3 Experiment Execution

This paper uses an input-oriented DEA model based on the variable return to scale hypothesis to analyses the relative efficiency of students' higher vocational English

Table 2. Descriptive Statistics of Sample Data (Time unit: hour)

Variable	Mean	Median	Max	Min	Sd	Skewness	Kurtosis
X1	94	93	126	53	17.60	0.31	2.63
X2	101	98	80	20	36.66	0.06	2.63
X3	80	76	420	0	90.53	1.57	5.63
X4	112	111	600	0	136.31	1.63	5.15
X5	176	172	840	0	222.43	1.71	5.03
X6	3	2.7	5	1	1.15	0.64	2.46
Y1	120	101	204	87	26.69	0.27	2.74
Y2	115	110	202	95	22.61	0.55	3.40
Y3	132	128	171	0	22.27	1.18	5.65
Y4	2.4	2.32	5	1	1.32	0.09	1.98
Y5	3.0	2.89	5	1	1.22	0.14	2.19

learning. Before data import, because the input indicators X3, X4 and X5 (students' after-class practice time in listening, reading, writing and translation) have zero data, they cannot be substituted into DEAP2.1 for data envelopment analysis.

3 Empirical Results and Analysis

The specific measurement results are shown in Tables 3 and 4.

Overall, 51 students average technical efficiency of college English learning as 0. 901, minimum value is 0. 556, shows that most of the students learning efficiency difference, the selection of college entrance examination, many students into the school with similar on a scale of the university entrance exam, after entering school teachers in English teaching and learning environment is close. As a result, their English learning

Table 3. College English learning efficiency of some of the 8 students

DU	TE	PTE	SE	SR
S1	0.97		0.97	increasing
S2	0.92	0.99	0.92	diminishing
S3	0.90	1.00	0.91	diminishing
…	…	…	…	…
S51	0.73	0.75	0.97	increasing
Mean	0.90	0.95	0.95	

* DU: Decision unit; TE: Technical efficiency; PTE: Pure technical efficiency; SE: Scale efficiency; SR: Scale remuneration.

Table 4. Interval statistics of the learning efficiency of 51 students in college English

TTEI	TE		PTE		SE	
	N	P	N	P	N	P
0.5–0.6	1	1.7	0	0.0	0	0.0
0.6–0.7	4	6.9	2	3.4	2	3.4
0.7–0.8	7	13.8	6	10.3	2	3.4
0.8–0.9	7	13.8	3	5.2	8	13.8
0.9 1	12	20.7	4	6.9	20	34.5
= 1	23	42	39	74.1	24	44.8

* TEI: The efficiency of interval; N: The number; P: Proportion; TE: Technical efficiency; PTE: Pure technical efficiency; SE: Scale efficiency; SR: Scale remuneration.

efficiency is similar. According to the statistical table of the interval of college English learning efficiency of 51 students (Table 4), there are 23 students with comprehensive effective DMU (technical efficiency = 1), accounting for 42% of the sample review, which indicates that about 42% of students do not reach the optimal level of input-output ratio in the process of higher vocational learning. In terms of pure technical efficiency, there are 39 people learning efficiency is 1, proportion is as high as 74.1%, show that the pure technology is invalid, the majority of students learning English is the cause of their comprehensive learning efficiency invalid scale efficiency is invalid, a reasonable distribution of students can't input indicators of college English learning, not to achieve the optimal configuration, the author analysis may be the reason is that, There are a large number of male students in science and engineering, their English foundation is relatively weak, their attitude towards English learning is poor, their investment is less, and they do not find suitable English learning strategies. Table 5 shows the statistical results of the 51 students' return to scale in English learning. It can be seen that 28 students are in the state of constant return to scale, accounting for 55%. There are 11 students in the state of decreasing returns to scale, accounting for 22%. These students need to reduce their English learning time appropriately and focus on improving learning efficiency. There are 12 students in the state of increasing returns to scale, and these students need to increase the use of after-class English training time and extracurricular resources to improve learning efficiency.

Table 5. Results of return to scale

Scale reward	The number of	Proportion %
The same	28	55
Diminishing	11	22
Increasing	12	23

Table 6. Projection analysis of college English learning of some of the 10 underqualified students

DM	Y1	Y2	Y3	Y4	Y5	X1	X2	X3	X4	X5	X6
S1	0.0	10.9	0.0	23.7	14.2	22.6	57.3	3.0	48.9	3.0	2.9
S11	7.2	0.0	0.0	50.4	37.8	16.0	10.4	65.3	59.6	87.6	10.4
S12	0.0	14.7	0.0	18.1	0.0	20.8	53.7	7.0	7.0	7.0	6.8
S15	0.0	0.2	0.0	42.7	0.0	22.6	55.5	7.0	7.0	7.0	68.9
S16	7.5	4.5	0.0	57.3	0.0	44.4	44.4	72.4	75.6	81.6	63.0
S20	2.0	0.0	0.0	53.9	0.0	15.9	15.9	16.0	60.8	62.5	15.9
S36	4.9	0.0	32.5	14.0	0.0	18.4	18.4	58.0	73.1	71.8	48.6
S40	0.0	7.6	0.0	18.5	0.0	25.7	25.7	29.1	52.9	24.1 ara>	39.4
S41	9.0	13.0	0.0	0.0	10.6	33.9	33.9	33.3	69.4	44.9	48.9
S49	0.0	0.0	0.0	0.0	0.0	29.0	29.0	40.9	47.9	41.4	29.0

Table 6 shows only the projection analysis results of some of the 10 students whose college English learning is not effective. It can be seen that the reasons for the efficiency loss of different students are quite different. For example, the main problem of student 1 is that the redundancy rate of the two input indicators of effective listening time and learning time after reading class is too high in the four semesters. Therefore, this student should improve his learning efficiency from these two dimensions. The main problem of student 2 is the lack of English improvement ability, which needs to be overcome. In addition, the utilization of listening learning time after class is also low. At the same time, other students in Table 6 also need to make targeted improvements according to the specific analysis results to improve their learning efficiency.

4 Conclusions

The BCC model (the input-oriented DEA model based on the variable return on scale hypothesis) was used to evaluate and measure the technical efficiency, pure technical efficiency, scale efficiency and return on scale of college English learning of 51 students. Nearly 75% of the students' learning efficiency is not effective, because the students' English foundation is poor, the input and learning output of learning and training time and extracurricular resources are not optimal. The analysis results give teachers a new idea, which is no longer limited to the evaluation of students' course learning by their performance, but can make a more objective quantitative analysis of the input and output of learning through the concept of relative learning efficiency, so as to understand the deficiencies in teaching, so as to improve the teaching effect.

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