

Research on Optimisation Strategies of Higher Vocational Education Practice Teaching- Based on the Comparative Analysis of RSR and TOPSIS

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Abstract

In order to improve the level of practical teaching and enhance students' vocational competence and professionalism, a questionnaire study was carried out at GZCCC University in China, which included 164 students, of whom 85 (52%) were female. The selected subjects were selected using simple random sampling and web-based survey to find out whether the students' perception of the form of practical teaching is in line with their psychological expectations and its role in their own career development. After analysing the results by comparing the RSR and TOPSIS methods, it was concluded that (1) there is a distributional difference between the forms of practice teaching that students psychologically anticipate and those that they frequently encounter; (2) Students ranked the importance of practical teaching for professional spirit such as being down-to-earth, self-discipline, professional ideals, and love of work behind professional abilities such as communication ability, teamwork, learning ability, and execution ability.

Keywords: Optimisation strategy, practical teaching, RSR, TOPSIS

1 Introduction

In January 2019, Chinese State Council issued the National Vocational Education Reform Implementation Programme, a legal document that proposes reforms of "teachers", "teaching materials" and "teaching methods". These three aspects play the roles of fundamentals, foundations and pathways respectively in the closed-loop system of high-quality technical and skilled personnel training, and solve the problem of "who to teach, what to teach and how to teach".

2 Literature Review

Practice teaching in higher vocational colleges and universities includes some typical forms of expression, highlighting ability cultivation ^[1] as the standard, mainly including professional competitions ^[2], knowledge lectures ^[3], teaching in training bases ^[4], scientific research projects ^[5] and other content. Even the Civics and Political Science programme also proposes to pay attention to the reform of practical teaching, open up second classroom positions, and carry out various forms of teaching and learning activities such as visits, competitions, and social practice^[6].

The literature that has been read shows that there are many common problems in the process of practical teaching in vocational education, whether it is applied undergraduate^[7], or higher

vocational^[8]; whether it is a professional course ^[9], or public courses such as ideology and politics ^[10], there are generally many problems such as the lack of systems and concepts, incomplete practical training venues, weak faculty, lack of deep integration of industry and education, and insufficient motivation of teachers and students, so as to take the implementation of national policies, Strengthening school-enterprise co-operation, reforming assessment methods and other measures, less involved in the first perspective of students, the lack of student demand and feedback information. Therefore, exploring the optimisation strategies from the micro perspective of the student group can not only enrich the case studies of practical teaching reform with novel entry points, but also make the reform more popular among students.

3 Research Modelling

3.1 RSR Model

Rank-Sum Ratio (RSR) is an indicator evaluation method proposed by Chinese scholar Tian Fengtiao in 1988. Initially, it was widely used in the fields of health management and medical science and technology, playing the roles of comprehensive evaluation, identification and classification, factor and correlation analysis, statistical monitoring, prediction and decision-making ^[11]. Subsequently, it has been cited by many scholars and used in educational evaluation and engineering programme measurement.

The calculation steps of the method are mainly divided into ^[12]:

a. Calculate the rank R_{ij} . The index values are ranked in a similar linear way to improve the shortcomings of the RSR method ranking method ^[13], so there is a quantitative linear correspondence between the ranked times and the original index values. For positive indicators, the larger the value, the more consistent with the expectation.

$$R_{ij} = 1 + (n-1) * \frac{x_{ij} - \min(x_{1j}, x_{2j}, x_{3j} \dots x_{ij})}{\max(x_{1j}, x_{2j}, x_{3j} \dots x_{ij}) - \min(x_{1j}, x_{2j}, x_{3j} \dots x_{ij})} \quad (1)$$

b. Calculate RSR_i . Compose a matrix with n rows and m columns. N corresponds to the evaluation object and m corresponds to the evaluation index information.

$$RSR_i = \frac{\sum_{j=1}^m R_{ij}}{n * m} \quad (i=1, 2, 3 \dots n, j=1, 2, 3 \dots m) \quad (2)$$

c. Determine the probability value Probability Y. Use the rank function to sort the values of RSR_i from smallest to largest in ascending order (the corresponding rank value means the larger the value of RSR_i the smaller the rank value), calculate the cumulative frequency value $\sum f$ by the frequency f of occurrence of each value of RSR_i , find the percentage and the probability distribution table to get the probability value corresponding to θ Probability Y.

$$\theta = \frac{\sum f}{n} * 100\% \quad (3)$$

d. Calculate the regression equation $\widehat{RSR}$.

$$\widehat{RSR} = \alpha + \beta * \text{Probability Y} \quad (4)$$

e. Determine the threshold ordering information. Determine the order of RSR_i by testing whether the regression equation reaches the level of significance, the larger the value, the more consistent with the expected level.

TOPSIS Model

TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) is an evaluation method first proposed by C.L. Hwang and K. Yoon in 1981, which ranks a finite number of evaluation objects according to their proximity to an idealised target, thus making a ranking of advantages and disadvantages [14].

The calculation steps of the method are mainly divided into [15]:

a. Calculate the normalisation matrix Z. Apply the formula $Z_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^n x_{ij}^2}}$ ($i \in n, j \in m$) to normalise the very large data [16] to obtain the $n \times m$ normalisation matrix Z.

$$Z = \begin{bmatrix} Z_{11} & Z_{12} & \cdots & Z_{1m} \\ \vdots & \vdots & \ddots & \vdots \\ Z_{nj} & Z_{n2} & \cdots & Z_{nm} \end{bmatrix} \quad (5)$$

b. Calculate the values of the optimal solution D_i^+ and the worst solution D_i^- . Calculate the maximum and minimum values for each evaluated object with respect to the

distances. Where $Z_j^+ = \max_i Z_{ij}$ is positive ideal solution, $Z_j^- = \min_i Z_{ij}$ is negative ideal solution.

$$D_i^+ = \sqrt{\sum_{j=1}^m (Z_j^+ - Z_{ij})^2} \quad (6)$$

$$D_i^- = \sqrt{\sum_{j=1}^m (Z_j^- - Z_{ij})^2} \quad (7)$$

c. Calculate the distance to the optimal solution C_i . A relatively large value of D_i^- indicates that the farther away the object is from the worst solution, the better the object is; a large value of C_i indicates that the evaluated object is better.

$$C_i = \frac{D_i^-}{D_i^+ + D_i^-} \quad (8)$$

4 Questionnaire Design And Description

4.1 Questionnaire Design

Aiming at students enrolled in higher vocational colleges and universities in GZCCC, Guangdong Province, China in 2023, 210 questionnaires were recovered in online form, and 164 valid questionnaires were obtained through data cleaning, with an effective rate of nearly 80%. Among them, male students accounted for about 48%, female students accounted for about 52%.

The questionnaire mainly contains two major parts of frequency description and importance evaluation, the first part is from the eight forms of classroom in-class practical training, professional competitions, knowledge lectures, innovation and entrepreneurship projects, scientific research projects, teaching in training bases, field visits to enterprises and others, to ask students about the frequency of encountering as well as liking in practical teaching. The second part is from 12 indicators such as love and respect for work, down-to-earth, vocational skills, and career aspirations^{[17][18]}, and the form of Richter's five-point scale^[19] was used to allow students to evaluate the facilitating effect of practical teaching.

4.2 Frequency Description

Students' views on practical teaching forms were investigated from two perspectives: frequently encountered and most expected. The data in Figure 1 show that for the eight forms of classroom training, professional competitions, knowledge lectures, innovation and entrepreneurship projects, scientific research projects, teaching in training bases, field visits to enterprises, and others, the proportions of his/her opinion that they are often encountered are about 30%, 21%, 17%, 11%, 9%, 6%, and 4%, approximately. However, the proportions of these eight forms most expected were about 13%, 13%, 8%, 16%, 19%, 24% and 7%, respectively. Both sides show different distributional differences. The three main areas with larger differences of about 10-18% are classroom in-class practical training, research projects and teaching at training bases. Those with smaller differences below about 10% are mainly in five areas, such as professional competitions, knowledge lectures, innovation and entrepreneurship projects, enterprise field visits and others.

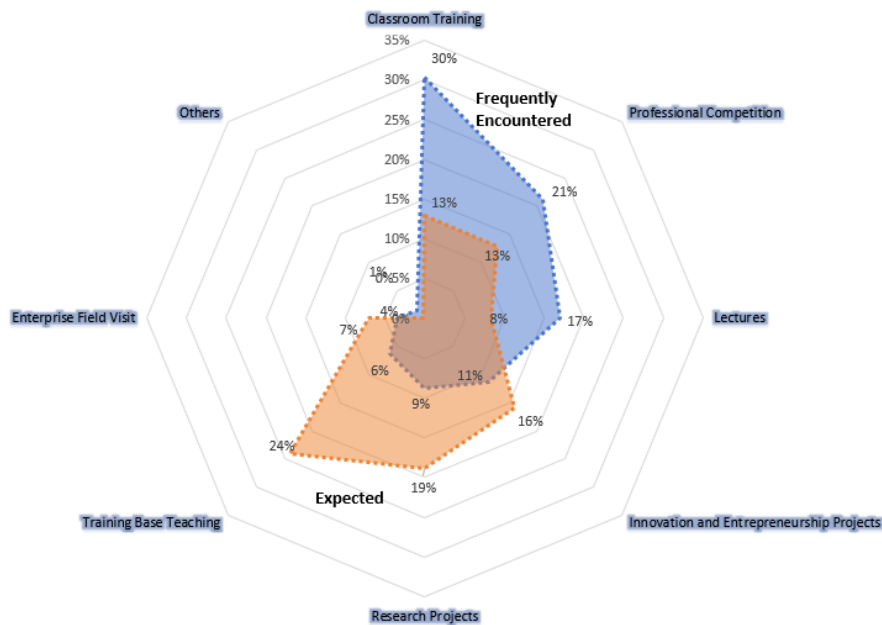


Fig. 1 Comparison of frequency information on the forms of practical teaching that students often encounter and most look forward for

5 Data Analysis

5.1 RSR Analysis

The RSR model calculation method can be used to obtain the information in Table 1. $X_1 \dots X_{164}$ is the original data collected, $R_1 \dots R_{164}$ is from (1), RSR is from (2) and θ is from (3). The magnitude of the RSR value indicates that the top four rankings are communication ability, teamwork ability, learning ability and execution ability, respectively. The next four in the ranking are footwork, self-discipline, career aspiration and love of work, respectively. Using RSR as the independent variable and Probability Y as the dependent variable, the formula from (4) was obtained through one-way linear regression analysis: Probability Y = .262 + .069 RSR ($P < .000$), $R^2 = .98$.

Table 1 RSR Indicator Ranking Information Table

Indicators	X_1	...	X_{164}	R_1	...	R_{164}	RSR	f	$\sum f$	θ	Probability Y	Rank
V_1	5	...	5	12.00	...	12.00	0.74	1	12	97.92	7.03	1
V_2	5	...	4	12.00	...	1.00	0.70	1	11	91.67	6.39	2
V_3	5	...	5	12.00	...	12.00	0.67	1	10	83.33	5.97	3
V_4	4	...	5	1.00	...	12.00	0.65	1	9	75.00	5.67	4
V_5	5	...	5	12.00	...	12.00	0.64	1	8	66.67	5.43	5
V_6	5	...	5	12.00	...	12.00	0.64	1	7	58.33	5.21	6
V_7	4	...	5	1.00	...	12.00	0.62	1	6	50.00	5.00	7
V_8	5	...	5	12.00	...	12.00	0.59	1	5	41.67	4.79	8
V_9	4	...	5	1.00	...	12.00	0.57	1	4	33.33	4.57	9
V_{10}	5	...	5	12.00	...	12.00	0.57	1	3	25.00	4.33	10
V_{11}	5	...	5	12.00	...	12.00	0.54	1	2	16.67	4.03	11
V_{12}	4	...	4	1.00	...	1.00	0.50	1	1	8.33	3.61	12

Note:

1) $V_1 \dots V_{12}$ represent communication ability, teamwork ability, learning ability, execution ability, vocational skills, innovation ability, adaptability, striving spirit, down-to-earthness, self-discipline, professional aspirations, and dedication to work, respectively. This is the same name of the variables represented in Form 3, Form 4.

2) 97.92 is estimated by $(1 - 1/(4 \cdot n))$ [20].

5.2 TOPSIS Analysis

The TOPSIS model calculations are used to obtain the information in Table 2. $x_1 \dots x_{164}$ are the raw data collected, $Z_1 \dots Z_{164}$ are from (5), D_i^+ from (6), D_i^- from (7), C_i from (8). The value of the optimal solution distance C_i indicates that the top four are professional skills, teamwork, learning and communication skills, and the bottom four are self-discipline, pragmatism, career aspirations and dedication to work.

Table 2 TOPSIS indicator ranking information table

Indicators	X_1	...	X_{164}	Z_1	...	Z_{164}	D_i^+	D_i^-	C_i	Rank
V_5	5	...	5	0.31	...	0.30	0.82	1.22	0.60	1
V_2	5	...	4	0.31	...	0.24	0.83	1.16	0.58	2
V_3	5	...	5	0.31	...	0.30	0.84	1.16	0.58	3
V_1	5	...	5	0.31	...	0.30	0.89	1.16	0.57	4
V_4	4	...	5	0.25	...	0.30	0.93	1.17	0.55	5
V_7	4	...	5	0.25	...	0.30	0.95	1.11	0.54	6
V_8	5	...	5	0.31	...	0.30	0.96	1.08	0.53	7
V_6	5	...	5	0.31	...	0.30	0.96	1.04	0.52	8
V_{10}	5	...	5	0.31	...	0.30	1.02	1.02	0.50	9
V_9	4	...	5	0.25	...	0.30	1.08	1.00	0.48	10
V_{11}	5	...	5	0.31	...	0.30	1.06	0.95	0.47	11
V_{12}	4	...	4	0.25	...	0.24	1.08	0.94	0.47	12

5.3 Comparative Results

Combining the information in Tables 1 and 2 leads to the results of the comparative analysis in Table 3. The information in Table 3 shows that the degree of difference in the evaluation results of the 12 evaluation indicators such as communication ability, which are derived from two different methods, RSR and TOPSIS, is not significant. The ranking of the 9 factors of teamwork ability, learning ability, executive ability, adaptability, striving spirit, down-to-earthness, self-discipline, career aspirations, and love of work are basically the same, with about only 1 rank difference. The ranking of the two factors, communication ability and vocational skills, is slightly different, with a difference of 3-4 grades each.

Table 3 Difference in levels of analysis between RSR and TOPSIS comparisons

Indicators	Rank_RSR	Rank_TOPSIS	Grade of Difference
V ₁	1	4	-3
V ₂	2	2	0
V ₃	3	3	0
V ₄	4	5	-1
V ₅	5	1	4
V ₆	6	8	-2
V ₇	7	6	1
V ₈	8	7	1
V ₉	9	10	-1
V ₁₀	10	9	1
V ₁₁	11	11	0
V ₁₂	12	12	0

Note: -3=1-4.

6 Conclusion

Frequency descriptions provide new entry points for improving the concept of student-centred teaching and learning. Student feedback on the eight specific forms of classroom-based practical training varied. The frequency of three forms, such as classroom in-class practical training, research projects and teaching in training bases, showed large differences, while the frequency of five forms, such as professional competition, knowledge lectures, innovation and entrepreneurship projects, and enterprise field visits, showed small differences. Thus, in the process of practical teaching, the three forms such as classroom in-class practical training can be further adjusted, while the five forms such as professional competition can continue to be maintained and improved.

The comparative analysis provides a new focus for the concept of dual cultivation of professional ability and professionalism. The comparative analysis of RSR and TOPSIS reveals that the five professional spirits of struggle, pragmatism, self-discipline, professional ideal and dedication are not sufficiently emphasised in the process of practical teaching, and that the education of students' professional qualities can be further strengthened by enhancing the realism of the simulation of the situation.

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