Online-Journals.org

iJET International Journal of Emerging Technologies in Learning

iJET | eISSN: 1863-0383 | Vol. 18 No. 14 (2023) | OPEN ACCESS

https://doi.org/10.3991/ijet.v18i14.41911

PAPER

# Evaluation of Students' Communicative Language Ability and Difference Analysis in an Interactive Teaching Environment

**Xin Zhao, Jiao Song(✉), Ru Wang, Fengming Jiao, Mingli Gao**

Jitang College, North China University of Science and Technology, Tangshan, China

songjiao@ncst.edu.cn

**ABSTRACT**

As the demand for cross-cultural communication has been increasing because of globalization, communicative language ability (CLA) has become an important component of quality education for college students. CLA evaluation and difference analysis help educators understand and identify problems and shortcomings of students in the learning process. However, most of the existing CLA evaluation and difference analysis methods focus on written and oral tests of college students in an interactive teaching environment, instead of evaluating actual communicative ability in the interactive environment. Therefore, this research aimed to study the CLA evaluation of college students and difference analysis in an interactive teaching environment. The environment for improving the CLA was analyzed first. After setting up five-level evaluation indexes for the CLA evaluation of college students in the interactive teaching environment, three methods were used to weight the CLA evaluation indexes, namely, the fuzzy analytic hierarchy process (FAHP), the entropy weight method (EWM), and the coefficient of variation method (CVM). Then a model for evaluating the CLA was constructed, which minimized the CLA improvement difference of college students. Finally, the experimental results verified that the proposed method was effective.

**KEYWORDS**

interactive teaching, communicative language ability of college students, language ability evaluation, language ability difference

## 1 INTRODUCTION

As the demand for cross-cultural communication has been increasing because of globalization, CLA has become an important component of quality education for college students. Meanwhile, with the continuous teaching environment reform and the widespread application of interactive teaching models, the improvement in teaching methods has created a profound impact on the CLA of students [1–6]. CLA evaluation

Zhao, X., Song, J., Wang, R., Jiao, F., Gao, M. (2023). Evaluation of Students' Communicative Language Ability and Difference Analysis in an Interactive Teaching Environment. *International Journal of Emerging Technologies in Learning (iJET)*, 18(14), pp. 150–163. https://doi.org/10.3991/ijet.v18i14.41911

Article submitted 2023-04-03. Resubmitted 2023-05-30. Final acceptance 2023-06-03. Final version published as submitted by the authors.

and difference analysis help educators understand and identify problems and shortcomings of students in the learning process, thus adjusting and optimizing teaching methods and strategies, and improving teaching effectiveness [7–11]. However, there is insufficient research on the CLA evaluation of college students and difference analysis in the interactive teaching environment [12–15]. Further exploration of this issue is of practical significance to teaching reform and CLA improvement of college students.

Effective communication skills are the demand of the 21st century, and students should master and develop these skills in the era of Industrial Revolution 4.0 (4IR). Communication skills, including written and oral skills, can be trained in physics learning by innovating and developing learning models. Kusuma and Susantini [16] aimed to establish a hypothetical Read-Outline-Discussion-Evaluation (RODE) model to practice communication skills. The model was designed by analyzing the advantages and disadvantages, learning theories, and empirical research of project-based learning models and problem-solving learning models, and by consulting scientific journals and related research results. The study was conducted through demand and literature analysis, and field observation. Irma et al. [17] conducted a quasi-experimental study, which aimed to investigate whether there was any difference in mathematical communication skills between students participating in Think-Pair-Share learning and those participating in traditional learning. Descriptive statistics and Mann-Whitney U evaluation were used by the researchers as data analysis techniques. A descriptive evaluation was used as the tool to measure the mathematical communication skills of students. Fatimawati and Odja [18] aimed to measure the communication skill improvement effectiveness of students in fluid topics using the learning setting of social media. A project-based learning model and a set of evaluations were used after pretest. The research was an experimental design study, and was part of research and development (R&D). The ADDIE learning kit consisted of a syllabus, course plans, materials, LKPD, testing and evaluation tools. It was concluded that the learning setting of social media effectively improved students' communication skills in fluid topics.

Most of the existing CLA evaluation and difference analysis methods focus on written and oral tests of college students in an interactive teaching environment, instead of evaluating actual communicative ability in the interactive environment, such as situational dialogues and group discussions. At the same time, the methods may have inconsistent evaluation standards and be affected by subjective factors significantly. In addition, most evaluation standards focus on language accuracy and fluency, and lexical richness, while neglecting the importance of contextual adaptability, cross-cultural communication skills and other aspects in practical communication. Therefore, this research studied the CLA evaluation of college students and difference analysis in an interactive teaching environment.

## 2 DETERMINING THE CLA EVALUATION INDEX WEIGHT

The environment for improving the CLA of college students included four key aspects, namely, knowledge reserve, language ability, communicative psychology, and situational context, as shown in Figure 1, which were described in detail in the following. First, knowledge reserve was the foundation for CLA improvement of college students, because students needed to have a rich reserve in vocabulary, grammar, sentence structures, and other aspects of the language. In addition, it was also important to understand the cultural knowledge and social background of the language. Second, language ability included four basic skills, namely, listening, speaking,

reading, and writing. Communicative psychology referred to the psychological state of students in the communication process, including their confidence, desire for communication, and ability to cope with stress and so on. Third, situational context involved the actual environment of using the language. By simulating real communication situations, students used and practiced the language in actual contexts, which helped them transform theoretical knowledge into practical communicative ability.

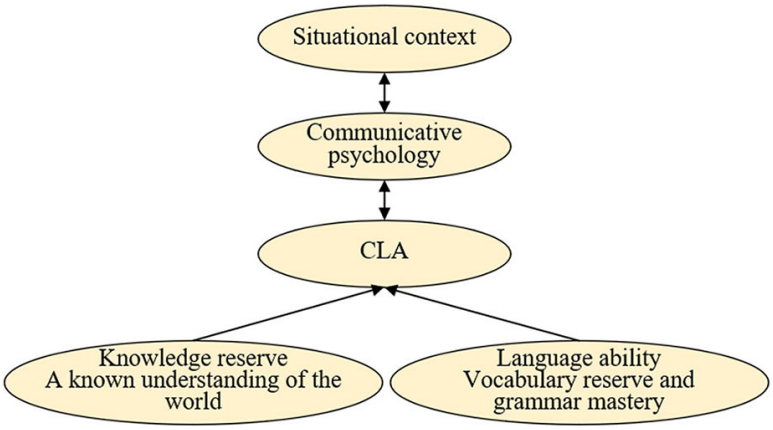


**Fig. 1.** Environment for improving the CLA of college students

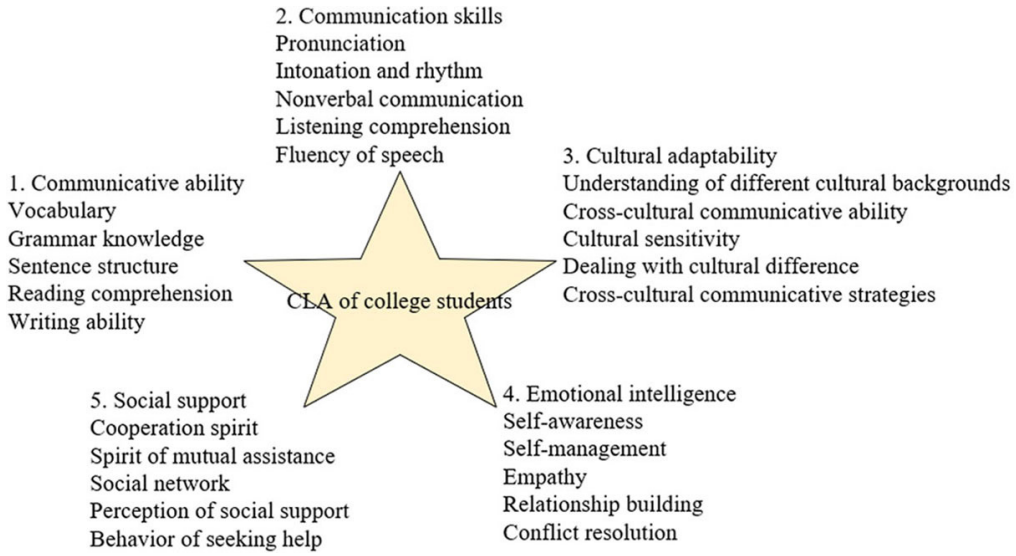


**Fig. 2.** CLA evaluation indexes for college students

Based on the understanding of the CLA environment improvement, this study set up five-level indexes to evaluate the CLA of college students in an interactive teaching environment, as shown in Figure 2.

Determining the evaluation index weight not only makes the evaluation results more objective, but also better reflects the relative importance of each CLA evaluation index. For example, contextual adaptability may be more important than language accuracy on a specific communicative occasion. In addition, the language ability of students was evaluated more accurately in specific communicative situations after a reasonable weight was determined. As a common decision analysis method, the combination weighting method combined subjective weighting with objective weighting to evaluate more reasonably and objectively. When being used

to determine the CLA evaluation index weight of college students, this method comprehensively considered the subjective evaluation of experts and the objective performance of data, which enabled the evaluation results to not only take into consideration the experience and knowledge of experts, but also avoid the limitation of excessive reliance on a single perspective, thus reflecting the true CLA of students more accurately.

The three main decision analysis methods, FAHP, EWM, and CVM, had their own characteristics and applicability. Their respective advantages were fully utilized when they were used for comprehensive evaluation index weighting. First, based on the subjective evaluation of experts, the FAHP took into consideration the mutual influence between various indexes, which reflected the relative importance of each index in actual communication more accurately. Second, based on the objective performance of data, the EWM determined each index weight by analyzing the dispersion degree of data, which avoided the problem of excessive reliance on the subjective judgment of experts. Third, also based on the objective performance of data, the CVM determined the weight by calculating the variation degree of each index, which better handled the uncertainty and complexity of data. Therefore, the comprehensive use of the three methods for CLA evaluation index weighting not only combined subjective evaluation methods with objective ones, but also handled the complexity and uncertainty of data, making the evaluation results more scientific and accurate. At the same time, this comprehensive weighting method also helped identify and improve the potential problems of the single evaluation method, enhanced the evaluation credibility, and was of great significance to CLA evaluation improvement of college students.

## 2.1 Weighting using the FAHP

In the FAHP, it's assumed that there were a total of $d$ indexes for evaluating the CLA in an interactive teaching environment. Let $A_i$ be the $i$-th index, and $\tilde{c}_{ij} = (e_{ij}, c_{ij}, g_{ij})$ be the triangular fuzzy number, satisfying $\tilde{c}_{ij} = 1/\tilde{c}_{ji}$, when $i,j = 1,2,...,d$, then the matrix $B'$ shown in the following formula was generated:

$$B' = \begin{array}{c} \\ A_1 \\ A_2 \\ \vdots \\ A_d \end{array} \begin{array}{c} \begin{array}{cccc} A_1 & A_2 & \cdots & A_d \end{array} \\ \begin{bmatrix} \tilde{1} & \tilde{c}_{12} & \cdots & \tilde{c}_{1d} \\ \tilde{c}_{21} & \tilde{1} & \vdots & \tilde{c}_{2d} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{c}_{d1} & \tilde{c}_{d2} & \cdots & \tilde{1} \end{bmatrix} \end{array} \tag{1}$$

The fuzzy synthesis degree $H_i$ of the $i$-th index was obtained by the following formula:

$$H_i = \sum_{j=1}^{d} B_{ij} \otimes \left[ \sum_{i=1}^{d} \sum_{j=1}^{d} B_{ij} \right]^{-1} \tag{2}$$

Addition of fuzzy numbers obtained $\sum_{j=1}^{d} B_{ij}^{j}$:

$$\sum_{j=1}^{d} B_{ij} = \left( \sum_{j=1}^{d} e_{j,} \sum_{j=1}^{d} c_{j,} \sum_{j=1}^{d} g_{j,} \right), i = 1,2,...,d \tag{3}$$

$$\left[\sum_{i=1}^{d}\sum_{j=1}^{d}B_{ij}^{j}\right]^{-1}=\left(\frac{1}{\sum_{i=1}^{d}\sum_{j=1}^{d}g_{ij}},\frac{1}{\sum_{i=1}^{d}\sum_{j=1}^{d}c_{ij}},\frac{1}{\sum_{i=1}^{d}\sum_{j=1}^{d}e_{ij}}\right) \tag{4}$$

Let $I$ be the relative size between indexes obtained based on the fuzzy synthesis degree value, then the contingency matrix expression was given by the following formula:

$$\mathrm{B'}=\begin{array}{c} \\ A_1 \\ A_2 \\ \vdots \\ A_d \end{array}\begin{array}{cccc} A_1 & A_2 & \cdots & A_d \\ / & \tilde{I}_{12} & \cdots & \tilde{I}_{1d} \\ \tilde{I}_{21} & / & \vdots & \tilde{I}_{2d} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{I}_{d1} & \tilde{I}_{d2} & \cdots & / \end{array} \tag{5}$$

Let $H_i = (e_i f_i g_i) \geq H_j = (e_j f_j g_j)$ be the degree of $\tilde{I}_{ij}$, given by the following formula. $I(H_i \geq H_j)$ and $I(H_j \geq H_i)$ were the prerequisites of comparing $H_i$ and $H_j$.

$$\begin{aligned}\tilde{I}_{ij}&=I(H_i\geq H_j)=\sup_{x>y}(\min\{\theta_{\tilde{B}}(y),\theta_{\tilde{B}}(x)\})=HE(H_i\cap H_j)\\&=\begin{cases}0, & if\ e_j\geq g_i\\ 1, & if\ c_i\geq c_j\\ \dfrac{e_j-g_i}{(c_i-g_i)-(c_j-e_j)}, & otherwise\end{cases}\end{aligned} \tag{6}$$

In the interactive teaching environment, the possibility degree of the $i$-th index being greater than all other CLA evaluation indexes of college students was calculated using the following formula:

$$\begin{gathered}I(H_i\geq H_1,H_2,...H_c,...,H_d)=I(H_i\geq H_2)...I(H_i\geq H_d)=\min I(H_i\geq H_c)\\ p=1,2,...,d\quad and\quad p\neq i\end{gathered} \tag{7}$$

$$l'(M_1)=\min I(H_i\geq H_c)\quad p=1,2,...,d\quad p\neq i \tag{8}$$

Let $K'$ be the weight vector of the FAHP weighting, then:

$$K'=(l'(M_1),l'(M_2),...l'(M_d))^T \tag{9}$$

The obtained weight vector was standardized based on the following formula. It should be noted that the weight $K_j$ of the $j$-th index was a non fuzzy number.

$$l(A_i)=\frac{l'(A_i)}{\sum_{i=1}^{d}l'(A_i)} \tag{10}$$

$$K=(l(A_1),l(A_2),...,l(A_d))^T=(K_1,K_2,...K_d) \tag{11}$$

## 2.2 Weighting using the EWM

In the EWM, it's assumed that $q$ evaluated objects and $p$ evaluation indexes of each object were used to construct the judgment matrix $RH = (h_{ij})_{q\times p}$, with $i = 1,2,3,...,q$ and $j = 1,2,3,...,p$. $RH$ was normalized to obtain the normalized matrix $G$. The following formula provided the element expression for the index, with the larger value meaning more satisfying, in $G$:

$$g_{ij} = \frac{h_{ij} - h_{\min}}{h_{\max} - h_{\min}} \tag{12}$$

The element expression for the index, with the smaller value meaning more satisfying, in $G$ was as follows:

$$g_{ij} = \frac{h_{\max} - h_{ij}}{h_{\max} - h_{\min}} \tag{13}$$

As for the evaluation index, with the larger value meaning more satisfied, in the above formula, let $h_{max}$ be the most satisfactory among different evaluation objects, and $h_{min}$ be the least satisfactory. Similarly, as for the evaluation index, with the smaller value meaning more satisfied, let $h_{min}$ be the most satisfactory among different evaluation objects, and $h_{max}$ be the least satisfactory. It's assumed $v_{ij} = g_{ij} / \sum_{i=1}^{q} g_{ij}$, then the entropy of CLA evaluation indexes of college students in the following interactive teaching environments was defined was follows:

$$O_j = -\left(\sum_{i=1}^{q} v_{ij} \ln v_{ij}\right) / \ln q \quad (i = 1,2,3,...,q; j = 1,2,3,...,p) \tag{14}$$

When $v_{ij} = 0$, $lnv_{ij}$ was meaningless. Therefore, the calculation of $v_{ij}$ was amended in this study as follows:

$$v_{ij} = (1 + g_{ij}) / \sum_{i=1}^{q} (1 + g_{ij}) \tag{15}$$

Finally, the entropy weight $N$ of various CLA evaluation indexes in the interactive teaching environment was obtained:

$$N_j = (1 - O_j) / \left(n - \sum_{j=1}^{p} O_j\right), \sum_{j=1}^{q} N_j = 1 \tag{16}$$

## 2.3 Weighting using the CVM

In order to avoid subjective preferences brought about by experiential weighting, the coefficient of variation (CV) of CLA evaluation indexes in the interactive teaching environment was further utilized to determine the weight. The eigenvalues matrix of evaluation indexes was constructed first. Let $\alpha_j$ be the CV of the $j$-th evaluation index, $C$ be the mean square error of the eigenvalue of the $j$-th evaluation index, satisfying $C = \sqrt{1/T \sum_{T=1}^{T} (b_j - \bar{b}_j)^2}, \bar{b}_j$ be the mean eigenvalue of the $j$-th evaluation

index, satisfying $\bar{b}_j = 1/T\sum_{T=1}^{T} b_{jT}$, and $B_j$ be the weight of the $j$-th evaluation index. The CV of the $j$-th index was calculated based on the following formula:

$$\alpha_j = C/\bar{b}_j \tag{17}$$

The weight of the $j$-th evaluation index was calculated using the following formula:

$$B_j = \alpha_j / \sum_{i=1}^{m} \bar{\alpha}_j \tag{18}$$

The combination weighting formula of the FAHP, the EWM, and the CVM was given by the following formula. Let $\lambda$ and $\beta$ be the preference coefficients, and $\lambda$, $\beta \in (0,1)$, then:

$$\hat{r}_j = \beta B_j + \lambda N_j + (1-\beta-\lambda)K_j \tag{19}$$

## 3 CLA EVALUATION CONSIDERING THE SCHEME DIFFERENCE

In order to minimize the CLA improvement difference of college students, the VIKOR (VlseKriterijumska Optimizacija l Kompromisno Resenje) evaluation method was used to construct a model for evaluating the CLA in an interactive teaching environment. As a multi-attribute decision analysis method, the VIKOR dealt with decision-making problems with multiple conflict evaluation indexes, and obtained a comprehensive evaluation value after considering all evaluation indexes, thus comprehensively evaluating the alternative CLA improvement solutions of college students. Meanwhile, the calculation process of this method was relatively intuitive and simple, making it easy to understand and operate. In addition, the evaluation values generated by the method intuitively reflected the proximity of alternative solutions to the ideal ones, which helped decision-makers make decisions. The CLA improvement of college students involved multiple factors and objectives, and the VIKOR method was precisely suitable for dealing with this multi-objective decision-making problem, which found a nearly ideal solution while meeting most of the objectives.

Let $\{M^{(1)}, M^{(2)},...,M^{(n)}\}$ be a total of $o$ alternative schemes for CLA improvement, $p$ be the number of CLA evaluation indexes of college students in an interactive teaching environment, the alternative scheme $q_{ij}$ be the value of $M^{(i)}$ under index $A_j$, $r_j$ be the weight of the $j$-th index determined by the combination weighting method, and $s_{ij}$ be the value of the $i$-th scheme under the $j$-th index, then the following formula provided the expression of the maximum group benefit $T$:

$$s_j^* = \max_j s_{ij}; s_j^- = \min_j s_{ij} \tag{20}$$

The following formula provided the expression of the minimum individual regret $U$:

$$s_j^* = \min_j s_{ij}; s_j^- = \max_j s_{ij} \tag{21}$$

Let $w$ be the weight of most criterion strategies, $V$ be the CLA improvement rate of college students generated by the scheme, $T^* = min\ T_i$, $T^- = maxT_i$, $U^* = min\ U_i$, and $U^- = maxU_i$, then the following formula determined:

$$T_i = \sum_{j=1}^{n} r_j (s_j^* - s_{ij}) / (s_j^* - s_j^-) \tag{22}$$

$$U_i = \max_j \left[ r_j (s_j^* - s_{ij}) / (s_j^* - s_j^-) \right] \tag{23}$$

$$V_i = w(T_i - T^*) / (T^- - T^*) + (1 - w)(U_i - U^*) / (U^- - U^*) \tag{24}$$

Let $M^{(2)}$ be the second best scheme of $V$ sorting, then there were:

$$V(M^{(2)}) - V(M^{(1)}) \geq 1 / (o - 1) \tag{25}$$

Let $M^{(1)}$ be one of the top CLA improvement schemes of $T$ or $U$. Schemes $M^{(1)}$ and $M^{(2)}$ were considered as the second best improvement schemes if they satisfied the inequation. Similarly, schemes $M^{(1)}$,$M^{(2)}$,...,$M^{(n)}$ were considered as the second best improvement schemes if they satisfied the inequation, with $M^{(n)}$ satisfying $M^{(n)}$-$M^{(1)}$≤1/($m$-1).

## 4 EXPERIMENTAL RESULTS AND ANALYSIS

Table 1 presents the evaluation results of the combination weighting method. The membership grade of each sample at the five levels (i.e., "excellent", "good", "medium", "poor", "extremely poor") can be seen in the table. The higher the membership grade, the higher scores of the sample at that level. The evaluation results in the table show the level corresponding to the highest membership grade of each sample. Sample 1 has the highest membership grade at the "extremely poor" level, indicating that the CLA evaluation results of this sample were extremely poor. Sample 2 has the highest membership grade at the "extremely poor" level, indicating that the CLA evaluation results of this sample were extremely poor. Sample 3 has the highest membership grade at the "poor" level, indicating that the CLA evaluation results of this sample were poor. Sample 4 has the highest membership grade at the "medium" level, indicating that the CLA evaluation results of this sample were medium. Sample 5 has the same highest membership grade at the "poor" and "extremely poor" levels, indicating that the CLA evaluation results of this sample may be between poor and extremely poor. Overall, the combination weighting method provided comprehensive evaluation results, which helped understand and improve the CLA of college students.

**Table 1.** Evaluation results of the combination weighting method

| Membership Grade for Each Level | | | | | | Evaluation Results |
|---|---|---|---|---|---|---|
| Sample No. | I | II | III | IV | V | |
| 1 | 0 | 0 | 0.1211 | 0.2374 | 0.3145 | V |
| 2 | 0.0612 | 0.1644 | 0.1641 | 0.1641 | 0.5134 | V |
| 3 | 0.1814 | 0.0151 | 0.0654 | 0.4511 | 0.1581 | IV |
| 4 | 0.2010 | 0.1974 | 0.2141 | 0.2214 | 0.0413 | III |
| 5 | 0.1412 | 0.0451 | 0.0647 | 0.3154 | 0.3151 | IV |

**Table 2.** Comparison of evaluation results using different methods

| Sample No. | FAHP | EWM | CVM | Combination Weighting |
|---|---|---|---|---|
| 1 | IV | V | V | V |
| 2 | IV | IV | V | IV |
| 3 | III | IV | IV | IV |
| 4 | III | III | II | II |
| 5 | V | VI | VI | VI |

Table 2 compares the evaluation results using different methods. The evaluation results of five samples using different evaluation methods (i.e., FAHP, EWM, CVM, and combination weighting method) can be seen in the table. For Sample 1, the evaluation results of the FAHP were "poor", while those of the other three methods were "extremely poor", maybe because the FAHP emphasized the interrelationships between the indexes more, while the EWM and the CVM focused more on the index information itself, indicating that different evaluation methods may give different results for certain samples. A similar situation applied to other samples, maybe because different evaluation methods processed evaluation indexes differently and had different focuses, indicating that multiple methods may need to be combined in order to obtain more comprehensive and accurate evaluation results. For certain samples, different evaluation methods may give the same or similar results. The combination weighting method combined the advantages of multiple methods, which considered both the interrelationships between indexes and the index information itself, thus providing more convincing results.

**Table 3.** Weight coefficients of the traditional method

| Sample No. | Communicative Ability | Communication Skills | Cultural Adaptability | Emotional Intelligence | Social Support |
|---|---|---|---|---|---|
| 1 | 0.04 | 0.08 | 0.41 | 0.23 | 0.24 |
| 2 | 0.14 | 0.09 | 0.47 | 0.22 | 0.08 |
| 3 | 0.22 | 0.21 | 0.21 | 0.32 | 0.04 |
| 4 | 0.37 | 0.29 | 0.08 | 0.25 | 0.01 |
| 5 | 0.04 | 0.07 | 0.78 | 0.07 | 0.04 |

According to the weight coefficients in Table 3, the distribution of various index weights in the CLA evaluation can be seen. In this case, "communicative ability", "communication skills", "cultural adaptability", "emotional intelligence", and "social support" were all considered as important factors affecting the CLA. However, the traditional weighting method overly relied on the subjective judgment of experts, which may lead to subjective bias. For example, according to the above table, the "cultural adaptability" scores of Sample 5 are much higher than the scores of other factors, while Sample 4 has higher scores in "communicative ability" and "communication skills". In this case, if a unified weight coefficient was used for evaluation, the difference between different indexes in each sample may be ignored, leading to inaccurate evaluation results.

**Table 4.** Weight coefficients of different methods

| Evaluation Index | FAHP | EWM | CVM | Combination Weighting |
|---|---|---|---|---|
| Communicative ability | 0.124 | 0.1844 | 0.1191 | 0.144 |
| Communication skills | 0.189 | 0.1915 | 0.1866 | 0.173 |
| Cultural adaptability | 0.244 | 0.2461 | 0.2421 | 0.2474 |
| Emotional intelligence | 0.237 | 0.186 | 0.2431 | 0.2211 |
| Social support | 0.206 | 0.192 | 0.2091 | 0.2145 |

Table 4 shows each evaluation index weight given by different evaluation methods. For the "communicative ability", FAHP and CVM gave lower weights, EWM gave the highest weight, and the weight given by the combination weighting method was between these three. For "communication skills", the four evaluation methods gave relatively close weights, indicating that the index was emphasized by the methods consistently. For "cultural adaptability", the four evaluation methods gave relatively high and close weights, indicating that it was considered very important in all evaluation indexes. For "emotional intelligence", FAHP gave a higher weight, EWM gave a lower weight, and the weights given by the combination weighting method and the CVM were between the two, maybe reflecting that the evaluation methods emphasized the index differently. For "social support", the four evaluation methods gave relatively close but slightly different weights, indicating that the index was emphasized by the evaluation methods somewhat similarly but with differences.

The combination weighting method combined the advantages of multiple methods and comprehensively and accurately reflected the importance of various evaluation indexes. Its weighting results effectively balanced the difference between the various methods, which obtained comprehensive evaluation results. Therefore, the combination weighting method was preferred to evaluate the CLA of college students.

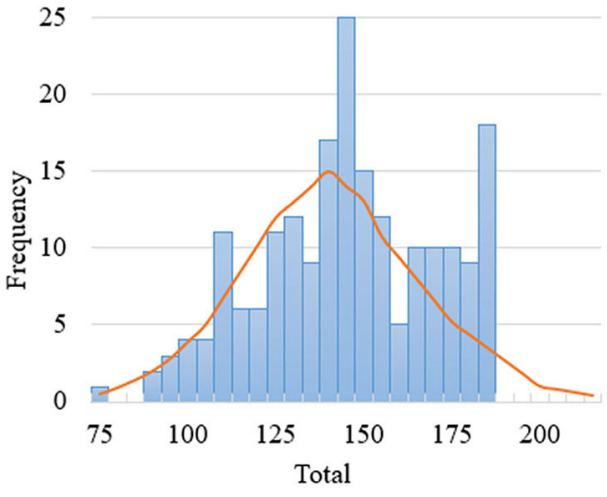


**Fig. 3.** Histogram

Figure 3 shows a histogram reflecting the total CLA scores of college students. It can be seen from the figure that the the "medium" and "good" columns have the maximum heights, meaning that most of the evaluated college students have medium or good CLA scores. However, the "excellent", "poor", and "extremely poor" columns have relatively low heights, indicating a relatively small number of students at these three levels. This

data distribution may indicate that the majority of the evaluated college students had medium to good CLA, with only a small number of them having excellent or significantly insufficient CLA. The results may suggest that there was still potential for the CLA development of most students, and more personalized and targeted teaching strategies and resources need to be provided to help them increase their CLA to a higher level.

According to the CLA evaluation results of college students in Table 5, it can be seen that the sampled students have different CLA in different indexes. The "communicative ability" of most students ranges from level III to IV, indicating their medium to good communicative ability, which may have improved because they have got enough opportunities for daily communication in college life. The students have significantly different "communication skills", ranging from level II to V, maybe reflecting the communication skill difference of students, because some students are more gifted or have got more training and practice in this aspect. The students generally have good performance in "cultural adaptability", with most of them ranging from level II to III, maybe meaning that they are able to adapt to different cultural environments, which to some extent reflects their global perspective and cross-cultural communicative ability. The "emotional intelligence" of students is different, ranging from level III to V, maybe because it involves more complex communicative ability, such as understanding other people's emotions and empathy, and students may differ greatly in this aspect. Most students have good "social support" ability between level II and III, maybe indicating that they can receive support in social environments and also provide support to others. The students have level II to VI CLA in "final judgment", with most students at level III, showing that most students have medium to good CLA. In addition, the "original credits" of students range from 49 to 86.5, with about 70 as the average scores, indicating that the students have generally good CLA. In summary, although the college students had different CLA to some extent, most of them had good CLA. For students with poor performance in certain aspects, targeted guidance and training may be needed to improve their CLA.

**Table 5.** CLA evaluation results of college students

| Index | Sample 1 | Sample 2 | Sample 3 | Sample 4 | Sample 5 |
|---|---|---|---|---|---|
| Communicative ability | IV | IV | III | III | III |
| Communication skills | IV | IV | V | IV⁺ | II |
| Cultural adaptability | IV | V | III | III | III |
| Emotional intelligence | V | V | III | V | IV⁺ |
| Social support | IV | IV | II | III | III |
| Final judgment | IV | IV | II | III | III |
| Original credits | 49 | 55.6 | 61.9 | 65.5 | 68.3 |
| **Index** | **Sample 6** | **Sample 7** | **Sample 8** | **Sample 9** | **Sample 10** |
| Communicative ability | II⁺ | III | III | III | III |
| Communication skills | II⁺ | IV⁺ | V | III | III |
| Cultural adaptability | II⁺ | III | III | II | III |
| Emotional intelligence | III | III | III | IV | III |
| Social support | III | II | II | III | III |
| Final judgment | II⁺ | III | II | III | III |
| Original credits | 70.5 | 72.9 | 78.3 | 82.3 | 86.5 |

Figure 4 shows the CLA improvement of college students before and after implementing the improvement scheme. According to the data in the figure, it can be seen that the CLA of college students has significantly improved after implementing the improvement scheme. The proportion of "excellent" students has increased from 35.0% to 51.0%, with an increase of 16 percentage points, indicating that the improvement scheme has significantly improved the CLA of students, and more students have obtained excellent CLA. Meanwhile, the proportion of "medium" students has decreased from 41.0% to 35.0%, maybe indicating that some students improved their ability level from "medium" to "excellent", which further confirms the effectiveness of the improvement scheme. The proportion of "poor" students has decreased from 24.0% to 14.0%, with a decrease of 10 percentage points, maybe meaning that the scheme implementation has improved students with originally poor CLA. Overall, the improvement scheme achieved positive results in improving the CLA of college students, which not only increased the proportion of excellent students, but also reduced the proportion of students with poor CLA, indicating that the scientific and effective scheme improved the CLA of college students, thus helping them better engage in interpersonal communication in their study, life, and future career.

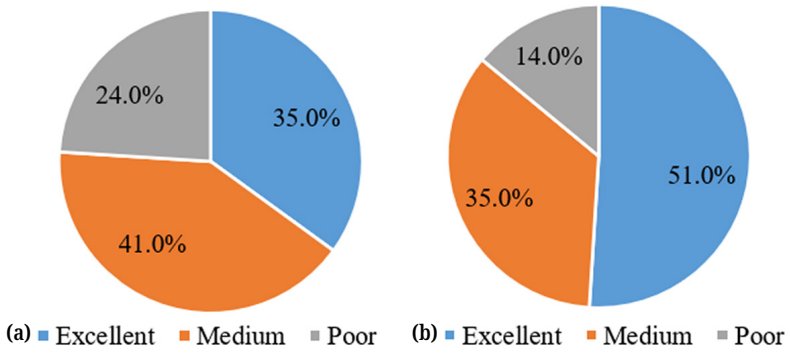


**Fig. 4.** CLA improvement of college students before and after implementing the improvement scheme

## 5 CONCLUSION

This research studied the CLA evaluation of college students and difference analysis in an interactive teaching environment. After analyzing the environment for improving the CLA, the five-level indexes were set for the CLA evaluation of college students in the interactive teaching environment. Then three methods of FAHP, EWM and CVM were used to weight the indexes. In addition, a model for evaluating the CLA was constructed, minimizing the CLA improvement difference of college students.

Combined with experiments, the evaluation results of the combination weighting method and the comparison results of different methods were presented in this study, which verified that the combination weighting method combined the advantages of multiple methods by considering both the interrelationships between indexes and the index information itself, thus giving more convincing results. Then a histogram reflecting the total CLA scores of college students was presented, and analysis conclusions were provided. This study further conducted a comparative experiment on the CLA improvement of college students before and after implementing the improvement scheme, provided the CLA evaluation results, and analyzed the CLA improvement before and after the scheme implementation. Finally, it was verified that the

scientific and effective scheme improved the CLA of college students, thus helping them have better interpersonal communication in their study, life and future career.

## 6 ACKNOWLEDGEMENT

This work was supported by Hebei Province Higher Education Teaching Reform Research and Project "Effectiveness Evaluation Construction of Hidden Curriculum of English Language Teaching in China Based on CIPP Model (Grant No.: 2022YYJG006)"; "Research on the Multiple Application of Ideological and Political Education in College English Based on Blended Teaching (Grant No.: 2022GJJG615)" and "Building the 'Golden Course' of College English under the U Campus Platform (Grant No.: 2019GJJG605)".

## 7 REFERENCES

[1] Saddhono, K., Hasanudin, C., Fitrianingsih, A. (2019). The Ability to Think Creatively on SSCS Using Schoology Apps, How is the Student's Language Metacognitive Awareness? Ingénierie des Systèmes d'Information, 24(4): 367–375. https://doi.org/10.18280/isi.240402

[2] Sabree, M., Mustafa, M.M. (2023). Importance and Role of Live Projects in Architectural Education Using a Descriptive and Analytical Approach. Education Science and Management, 1(1): 7–18. https://doi.org/10.56578/esm010102

[3] Budiman, T., Franky, F. (2021). The Relationship Pattern of Internet Usage Frequency, Generation Z Characteristics, and Teaching Method in the Millennium Era. International Journal of Interactive Mobile Technologies, 15(18): 178–185. https://doi.org/10.3991/ijim.v15i18.24555

[4] Sun, X., Zhang, X., Lei, L. (2022). The Effects of Online Role-play Teaching Practice on Learners' Availability for Resources. International Journal of Emerging Technologies in Learning, 17(5): 4–18. https://doi.org/10.3991/ijet.v17i05.30575

[5] Levitskyi, A., Benzar, I., Vitiaz, V., Golovatiuk, D., Karabenyuk, O. (2021). Teaching Pediatric Surgery in the Online Environment: Challenges and Opportunities. International Journal of Online and Biomedical Engineering, 17(5): 119–132. https://doi.org/10.3991/ijoe.v17i05.22051

[6] Dahal, N., Pant, B.P., Shrestha, I.M., Manandhar, N.K. (2022). Use of GeoGebra in Teaching and Learning Geometric Transformation in School Mathematics. International Journal of Interactive Mobile Technologies, 16(8): 65–78. https://doi.org/10.3991/ijim.v16i08.29575

[7] Nguyen Tien, L., Do Thi Minh, T., Pham, S.V. (2022). Awareness of Cultural Approach in Engineering Teaching by Lecturers: A Literature Review. International Journal of Engineering Pedagogy, 12(1): 21–32. https://doi.org/10.3991/ijep.v12i1.24961

[8] Trogden, B.G., Mazer, J.P. (2019). From Cornerstone to Capstone: Perspectives on Improving Student Communication Skills Through Intentional Curricular Alignment. In Communication in Chemistry, pp. 17–28. https://doi.org/10.1021/bk-2019-1327.ch002

[9] Md Nujid, M., Tholibon, D.A. (2023). Evaluation of Learners' Academic Performance in Teaching and Learning Civil Engineering During the COVID-19 Pandemic. International Journal of Engineering Pedagogy, 13(3): 41–53. https://doi.org/10.3991/ijep.v13i3.30147

[10] Dan, Z. (2017). Online Learning Platform and Innovation of English Teaching Model Based on Students' Foreign Language Learning Ability in Independent College. Boletin Tecnico/Technical Bulletin, 55(6): 670–677.

[11] Wang, Q. (2022). Application of Six Sigma Management-Based Teaching Method in Financial Management Course Online Teaching. International Journal of Emerging Technologies in Learning, 17(1): 60–73. https://doi.org/10.3991/ijet.v17i01.28269

[12] Cismas, S.C. (2010). Foreign language technical writing abilities for power engineering students in the polytechnic university of Bucharest. In Proceedings of the 7th WSEAS International Conference on Engineering Education, Corfu Island, Greece, pp. 305–310.
[13] Page, G., Tay, H.F. (2022). Reflections on the applied business analytics student writing project. In Computer Science and Education in Computer Science: 18th EAI International Conference, CSECS 2022, On-Site and Virtual Event, pp. 274–281. https://doi.org/10.1007/978-3-031-17292-2_22
[14] Sun, Y., Li, X. (2020). Research on the application of teacher-student collaborative assessment in business English writing teaching. In 2020 International Conference on Computers, Information Processing and Advanced Education (CIPAE), Ottawa, ON, Canada, pp. 338–340. https://doi.org/10.1109/CIPAE51077.2020.00090
[15] Chang, W.L., Lee, C.Y. (2013). Trust as a Learning Facilitator that Affects Students' Learning Performance in the Facebook Community: An Investigation in a Business Planning Writing Course. Computers & Education, 62: 320–327. https://doi.org/10.1016/j.compedu.2012.11.007
[16] Kusuma, A.E., Susantini, E. (2020). Physics innovative learning: RODE learning model to train student communication skills. Journal of Physics: Conference Series, 1422: 012016. https://doi.org/10.1088/1742-6596/1422/1/012016
[17] Irma, A., Juandi, D., Dahlan, J.A., Nirawati, R. (2020). The effect of think-pair-share cooperative learning on student mathematical communication skills. Journal of Physics: Conference Series, 1521: 032033. https://doi.org/10.1088/1742-6596/1521/3/032033
[18] Fatimawati, S., Odja, A.H. (2020). The effectiveness of learning using social media to improve student's communication skills in fluids' topics. Journal of Physics: Conference Series, 1521: 022062. https://doi.org/10.1088/1742-6596/1521/2/022062

## 8 AUTHORS

**Xin Zhao**, associate professor at North China University of Science and Technology, received Master of Arts in Foreign Language School, Yanshan University, in 2011. Her research focuses on Language Testing and Evaluation, English Language Teaching, Intercultural Communication. Email: zhaoxin@ncst.edu.cn

**Jiao Song**, associate professor at North China University of Science and Technology, received Master of Arts in Foreign Language School, Hebei United University, in 2013. Her research focuses on English Language Teaching, Second Language Acquisition. Email: songjiao@ncst.edu.cn

**Ru Wang**, associate professor at North China University of Science and Technology, received Master of arts in Foreign Language School, Hebei United University in 2012. Her research focuses on English Language Teaching, Intercultural Communication. Email: wangru@ncst.edu.cn

**Fengming Jiao**, received her M.A. from Yunnan Minzu University and started her teaching career since 2016 in North China University of Science and Technology. She has published 10 papers on English teaching, attended 4 projects at provincial level, and has been in charge of 2 projects at provincial level. Email: tstsdah@163.com

**Mingli Gao**, received her master's degree in foreign languages and literatures in 2015 from North China University of Science and Technology. Now she is a lecturer in Jitang College of North China University of Science and Technology. At the same time, she is also a doctoral student at De La Salle University. Her current research interests include applied linguistics, cognitive linguistics and college English teaching. Email: gaomingli@ncst.edu.cn