Application of Multivariate Video Analysis in English Teaching Effect Evaluation Based on Computational Neural Model Simulation

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ABSTRACT

Video observation and content analysis are used to make a "quantitative-qualitative" analysis of English teachers' teaching behavior reflected in English classroom teaching videos, and to accurately describe, analyze, and summarize the characteristics of English teachers' teaching behavior from various aspects. Based on this, this study uses video analysis methods and NVivo 11 qualitative analysis tools to import quantitative data obtained from teaching video content into Excel tables for statistical analysis, objectively describe the rules and characteristics of junior high school English teachers' teaching effects, and then put forward suggestions to optimize teaching effects and strategies and suggestions to promote English classroom development. This paper establishes a video analysis and evaluation model. First, calculate the weights required by the model, then calculate the relationship matrix, and then calculate the second-level video analysis and evaluation. Using the second-level weight and relationship matrix, the teacher's evaluation value will be obtained.

KEYWORDS

Classroom Assessment, Middle School English, Video Analysis of Teaching

INTRODUCTION

The evaluation of English teaching effect is helpful to improve the teaching effect (DeMers et al., 2021). The key is to accurately grasp and evaluate the effect of classroom teaching of middle school English teachers (Manghani et al., 2020). It establishes a video analysis and evaluation model. First, calculate the weights required by the model, then calculate the relationship matrix, and then calculate the second-level video analysis and evaluation. Using the second-level weight and relationship matrix, the teacher's evaluation value will be obtained (Joy et al., 2021). The third pair and school can well meet the current needs of various educational evaluation fields.

In addition, in the past teaching evaluation, qualitative analysis method is often used. It also causes difficulties for the evaluators in specific operations. but this method often ignores the existing factors (Ha, 2021). Therefore, it is scientific.

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With the development and application of the Internet, there has emerged a general method that uses teaching coding to interpret and analyze teaching content, and then achieve visual and understandable data quantification results (Dharmawardene&Wijewardene, 2021).Therefore, in order to understand the practical application of quantitative content analysis method of classroom video in educational research, the author selected six provincial-level high-quality English classroom recording videos in the educational resource platform of "one teacher, one excellent course" as research cases, to analyze the effect of English teachers' teaching. The proportion of teachers' TPACK knowledge structure is used as "quantitative-qualitative" statistics and analysis, to expand the application research of video quantitative content analysis in teaching effect (Tamur et al., 2020). At present, with the continuous development of the Internet, intelligent technology and the promotion of teaching reform in China, the traditional teaching mode and evaluation mode have undergone significant changes. The traditional English teaching evaluation methods are relatively simple. Generally, the evaluation results are obtained by comparing the scores and the degree of completion of practical teaching. Although the expected evaluation results can be achieved, they are easily affected by external teaching factors in the actual processing process. The final evaluation results of English teaching effects are not accurate and reliable.

To solve the above problems, in this paper, the multivariate video analysis method is used to evaluate English classroom teaching in middle school (Yan, et al., 2015). The methods used include a scoring method, fuzzy comprehensive evaluation, and other methods. It can be seen that the evaluation of the effect of middle school English classroom teaching is a fuzzy comprehensive evaluation (Thompson, et al., 2022). The traditional comprehensive evaluation methods will be in such a field. To solve specific problems in a specific field, it is necessary to integrate and analyze the system based on the actual situation, and then re-establish a suitable system, which can be realized by suitable algorithms (Chien et al., 2020). Therefore, this paper proposes that this research has one. At the same time, other professional comprehensive evaluation methods also have reference value.

BACKGROUND

Teaching Evaluation

There are problems of evaluation subject and evaluation object. In addition, the evaluation methods have similarities and differences, and there are quantitative and non-quantitative points. Simply put, the value judgment of things by numerical quantitative methods is called quantitative evaluation (Zhang et al., 2020). This method is generally used to clarify the level of the object's memory ability. There are great limitations, and the non-numerical quantitative method is used for value judgment, which is called qualitative evaluation.

Evaluation of English Classroom Teaching

"English Curriculum Standards" pointed out that it is the teaching process that allows students to develop their abilities in an all-round way and teachers to get feedback from students in a timely manner and promote it (Ministry of Education of the People's Republic of China, 2003; Yun et al., 2020). In the evaluation of other methods in the process of English teaching, it can make a judgment on the learning attitude, interest, and English ability of students and promote the enthusiasm of students (Hu & Yang, 2022). The evaluation method of classroom teaching should follow the following principles.

The Principle of Integrity

They are reasons that have effects in middle schools. In the process of selecting indicators, such evaluation will be noted. The standard of recording is in seconds, logical division is performed once per second, and there is about one code in one minute of class (Qadha & Alward, 2020). Taking time as a unit can better reflect quantification and objectivity, but it is not conducive to the overall understanding of teaching events in teaching activities. Moreover, there are certain difficulties in

operation, and the effect of promotion cannot be achieved, which is not conducive to the promotion of the idea.

The Principle of Authenticity

The principle of authenticity, also known as the principle of objectivity, refers to the fact that the accounting of an enterprise should be based on the actual economic business, and truthfully reflect the financial status and operating results of the enterprise (Du, 2021).

The Principle of Maneuverability

Maneuverability is an important tactical and technical indicator of an aircraft. It refers to the ability of an aircraft to change its flight speed, flight altitude and flight direction within a certain period of time. Obviously, the less time it takes for an aircraft to change a certain speed, altitude, or direction, the better the maneuverability of the aircraft.

The Principle of Simplicity

It aims to develop a simple and feasible classroom teaching analysis method, so that classroom video analysis is not only used for research, but also enables every front-line teacher to complete the evaluation of teaching by themself (Mamatova, 2020). From this point of view, it proves once again that it is necessary to divide small teaching activities as units.

MATERIALS AND METHODS

Classroom Video Analysis

The classroom video analysis mentioned in this article refers to the logical division and dimension marking of classroom videos through the set coding dimension table to form data graphics (Banihani, 2021; Jan, 2022). Finally, the teaching is analyzed and evaluated by combining data graphics, teaching videos, teaching design, and other teaching resources.

Class video cases have received extensive attention from many researchers due to their authenticity, hypertext, situational, and other characteristics (Arifani & Asmana, 2021). Experts and scholars have made certain definitions of video cases. Although they are slightly different, the overall essence is the same as classroom video. The case uses filming and video editing technology and relies on teaching design to integrate classroom teaching and teaching-related resources for learners to learn (Susanto & Kardena, 2021). The video case referred to is the same here, the difference is that the source of the case is limited to the classroom video case of normal students in the discipline of information technology, as shown in Figure 1.

As a new field of Berelson's explicit content education technology research, Klinger believes that quantitative dissemination of content is a means to achieve other research purposes (Kar, 2014). The essence of quantitative content analysis is the process of quantitatively classifying, coding, analyzing, and making reproducible and effective inferences about the content with data (Zhang & Wang, 2022). As far as the research process is concerned, quantitative content analysis includes five steps: determining the research purpose, extracting research samples, determining the analysis unit, specifying the classification code, and content statistics and analysis, and has the characteristics of objectivity, systematicness, and quantification. For the traditional evaluation of English teaching effect, relevant personnel need to select evaluation indicators representing different directions. They can first seek the opinions of teachers in schools, enterprise tutors, and evaluation experts, and gradually build an intelligent evaluation database with intelligent screening technology. Then they can identify and classify the evaluation indicators of English courses, and then select evaluation indicators accordingly.

Classroom teaching activity is an overall activity that includes "teaching" and "learning," as well as the process of teacher-student interaction, so classroom teaching evaluation should be carried

Figure 1. Multivariate video analysis system and process
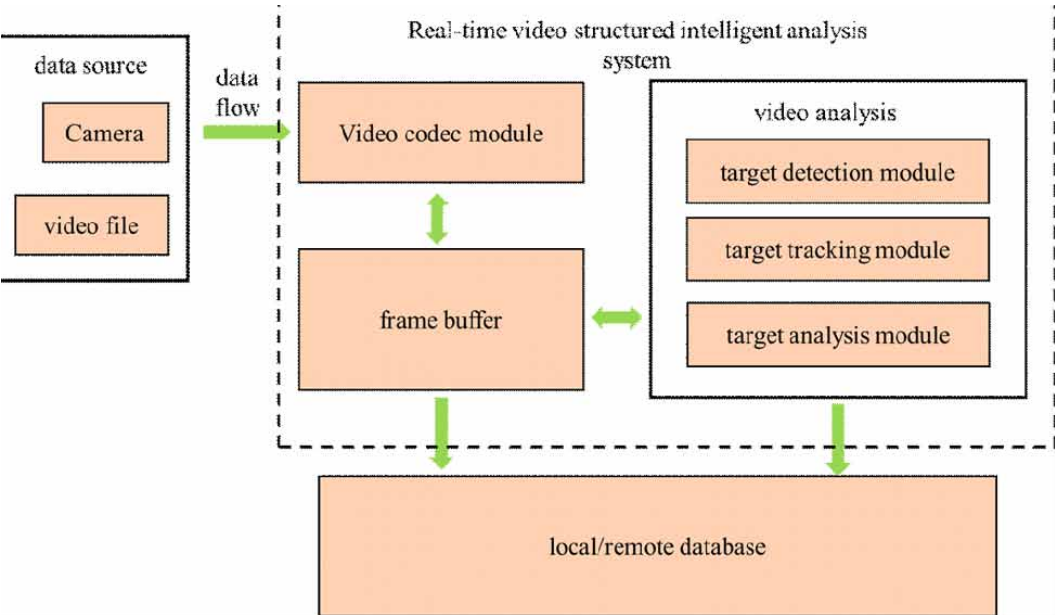
out from its overall perspective. The basis of classroom teaching is teaching design, which is the key basis to ensure the smooth development of teaching activities. Teaching implementation is the detailed process of teaching steps, and in this process, the needs of teachers and students in classroom teaching activities can be met, and the teaching objectives can be achieved gradually. The ultimate goal of classroom teaching is to promote students' development, so classroom teaching should be evaluated based on classroom teaching effect. In addition, the integrated course is a process of self-construction and self-exploration of students with the help and guidance of teachers and the support of a certain good teaching environment. The good teaching atmosphere and the condition of the teaching media and equipment themselves are important guarantees to guide students to continue to learn. Therefore, it is necessary to establish scientific evaluation standards for the teaching environment in classroom teaching. Therefore, the evaluation of integrated English classroom teaching should be systematically evaluated from four aspects: teaching design, teaching implementation, teaching effect, and teaching environment.

Combined with the above analysis, this study strictly follows a three-step strategy. First of all, this research aims to explore the teaching behavior of high-quality English teachers in junior high schools and selects 6 saving-level high-quality junior high school English classroom recording videos in the educational resource platform of "one teacher, one excellent course" as research samples; secondly, according to teachers' teaching behavior and E-TPACK structure, the coding scale strictly codes the teachers' language, movement, technology use, and other behaviors in the video; finally, the coded data information is statistically and quantitatively analyzed to form an objective and systematic conclusion. In addition, the evaluation methods have similarities and differences, and there are quantitative and non-quantitative points. Simply put, the value judgment of things by numerical quantitative methods is called quantitative evaluation (Song & Montenegro-Marin, 2021). Quantitative evaluation is to use mathematical methods to collect and process data and make a value judgment on the quantitative results of the evaluation object. Quantitative evaluation emphasizes quantitative calculation and is based on educational measurement. It is characterized by objectification, standardization, accuracy, quantification, and simplification. Qualitative evaluation is not a mathematical method, but a

value judgment based on the evaluator's observation and analysis of the evaluation object's usual performance, reality, and status or literature.

Analysis of Mainstream Coding Systems

The authors analyze the existing mainstream classroom analysis and coding methods from the aspects of theoretical support, coding system, and recording standards.

Theoretical Basis

Teaching activities are mainly carried out in the form of speech, and language behavior, which accounts for all teaching behaviors, is the main teaching behavior in the classroom. In addition, because of the explicit behavior of teachers and students, it is convenient for the evaluator to make an objective record of the facts (Ruipérez-Valient et al., 2022). On this basis, one can think that to a certain extent, grasping the language behavior also grasps such essence of classroom teaching.

Obviously, the current classroom, especially the classroom of information technology, has many teaching behaviors of operational demonstration, and the weight of the teaching behavior in which the language behavior is located has been greatly reduced. Since language behavior can no longer be used as the main teaching behavior, can one jump to a higher dimension and use teaching activities as the basic analysis unit? (Shang, 2022). Based on the idea of teaching design, a class must be composed of many small and relatively independent teaching activities. Each small teaching activity has its own specific goal (Huang & Fu, 2019). In this way, if a suitable dimension can be found to conduct a comprehensive analysis of a single small teaching activity, then the teacher's teaching status can be objectively displayed.

Coding System

The coding dimension has been improved and developed based on the Flanders Interaction Analysis System. Although there are influencing factors added to modern technology, there is supplementary analysis of the silent situation, and some dimensions are added and adjusted based on the real situation. However, most of the dimensions are still in the dimension of language interaction and are mainly based on teacher language analysis.

This is definitely impossible to evaluate correctly in a classroom that focuses on operation demonstrations. Even for non-operational courses, with the advocacy of student dominance, the classroom form has long since separated from the state where teachers teach and students listen. If the language of teachers and students is the main body, the accuracy will be lost. Summarizing the past coding dimensions, it can be found that its objects are divided into teacher language, student language, technology, and silence. Such a division dimension cannot be understood from the overall of teaching activities. If the two-round coding method is used for reference, this problem can be solved. First, the classroom is divided according to the teaching activities, and then the qualitative linguistic and non-linguistic multi-dimensional analysis of each small teaching activity is carried out.

Recording Standards

The standard of recording is in seconds, logical division is performed once per second, and there is about one code in one minute of class.

Taking time as a unit can better reflect quantification and objectivity, but it is not conducive to the overall understanding of teaching events in teaching activities. Moreover, there are certain difficulties in operation, and the effect of promotion cannot be achieved, which is not conducive to the promotion of the idea of "teacher becoming a researcher." This paper aims to develop a simple and feasible classroom teaching analysis method, so that classroom video analysis is not only used for research, but also enables every front-line teacher to complete the evaluation of teaching by themselves. From this point of view, it proves once again that it is necessary to divide small teaching activities as units.

From the analysis of the above three aspects, we can conclude that it is of great significance to change the past time as the basic unit and change the teaching activity as the basic unit. The unit of analysis based on teaching activities is a high-level abstraction from the unit of analysis based on language. A true assessment of the classroom can be done with less time and less effort.

In the scoring process, there are some subjective factors, the evaluation of the indicators themselves are ambiguous, and the indicators have multi-level phenomenon. In order to more scientifically evaluate English classroom teaching in middle schools, researchers have proposed many methods, such as mathematical statistics, genetic algorithms, artificial intelligence and other methods. Although accurate conclusions can be obtained, the calculation process is complicated and not suitable for the actual needs of the work. Through expert advice and practice, the authors used the method of multivariate video analysis in Figure 2 to evaluate.

The implementation process of teaching evaluation in this study mainly included two aspects:

1. Establish a classroom teaching evaluation team. During the evaluation research on the integration of English teaching in junior high school, an evaluation team consisting of 10 members was established, including three teachers with senior professional titles in middle school, three experts, and four students.
2. Determine the target teacher. This study took an English class as an example. Ten group members participated in classroom observation during the class of two teachers and made comments on their classroom teaching.

Weight Calculation

According to the reliability and validity tests, the commonality (common factor variance) coefficients of the four first-level indicators were all above 0.8, indicating that each variable was suitable for factor.

Figure 2. The process of teaching evaluation practice
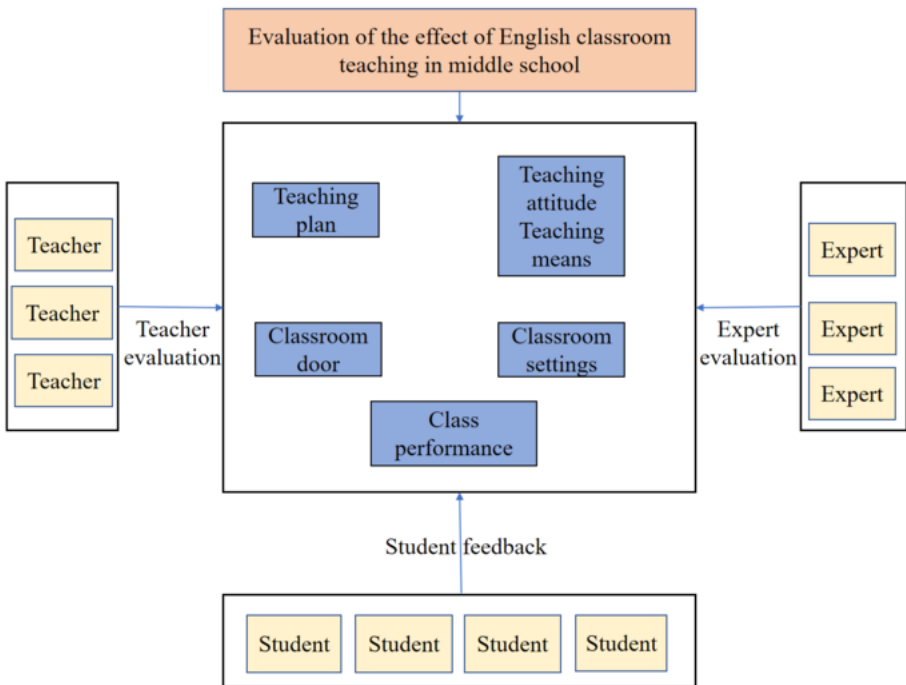
In addition, four first-level indicators fell into one factor, and the principal component explained 94.180% of the total variance. Therefore, the factor analysis results of the four first-level indicators were consistent with the theoretical concept of the scale, indicating that the scale had good structural validity in determining the dimensions of the four first-level indicators.

Through literature analysis and data validation, this paper has obtained the evaluation scale of junior high school English teaching integration. However, in order to put it into practical use, it is also necessary to consider the internal relationship between the "quality" and "quantity" of the evaluation system. The system structure formed by it reflects the "quality" relationship, while its weight setting reflects the "quantity" relationship between the indicators. The digital weight can make teachers more clearly see the real situation of classroom teaching under the integrated conditions, which is of key significance for the quantitative evaluation of the scale of this study.

The experts include n first-level indicators, namely: 1U, 2U …, nU, indicators are 1C, 2C …,nC . They are: 1K, 2K, 3K ..., nK, then the in middle school are 11C, 12C, 13C …,11kC, 21C , 22C , 23C ,…, 22kC , … , n1C , n2C , n3C ,…, nnkC . there is n first-level and the entire target is 1, so formula (1) is satisfied:

$$C_1 + C_2 + \ldots + C_n = 1 \tag{1}$$

Indicators experts, in middle school, so they all meet the calculation indicators of experts, students and teachers, such as formula (2):

$$C_i = C_{i1} + C_{i2} + \ldots + C_{ik_i} (i = 1, 2, \ldots, n) \tag{2}$$

which is:

$$\begin{cases} C_1 = C_{11} + C_{12} + \ldots + C_{1k_1} \\ C_2 = C_{21} + C_{22} + \ldots + C_{2k_2} \\ \quad \ldots \\ C_n = C_{n1} + C_{n2} + \ldots + C_{nk_n} \end{cases} \tag{3}$$

such middle school will be:

1. Such scores formula (4):

$$F_i = F_{i1} + F_{i2} + \ldots + F_{ik_i} (i = 1, 2, \ldots, n) \tag{4}$$

The total scores F of the secondary indicators of experts, students, and teachers respectively satisfy the following formula (5):

$$\begin{cases} F = F_1 + F_2 + \ldots + F_n \\ F = F_{11} + F_{12} + \ldots + F_{1k_1} + F_{21} + F_{22} + \ldots + F_{2k_2} + \ldots + F_{n1} + F_{n2} + \ldots + F_{nk_n} \end{cases} \tag{5}$$

2. There is ijC middle school jth secondary indicator of the ith primary indicator branch, and ijF is the ith primary indicator branch. Calculate it to obtain formula (6):

$$C_{ij} = \frac{F_{ij}}{F} \qquad (6)$$

3. For the weight of experts, and (7), (8), and (9):

$$\begin{cases} C_{11} = \dfrac{F_{11}}{F} \\ C_{12} = \dfrac{F_{12}}{F} \end{cases} \qquad (7)$$

$$\begin{cases} C_{21} = \dfrac{F_{21}}{F} \\ C_{22} = \dfrac{F_{22}}{F} \end{cases} \qquad (8)$$

$$\begin{cases} C_{31} = \dfrac{F_{31}}{F} \\ C_{32} = \dfrac{F_{32}}{F} \end{cases} \qquad (9)$$

First, calculate the total score F of the expert's second-level index, then calculate the weight of the second-level.

Membership Matrix Calculation

The relationship of middle school classroom teaching. The result set V, and all the information obtained by set U is shown in formula (10):

$$r_{ij z} = \frac{N_{ij z}}{m} \qquad (10)$$

Among them, ijN is for evaluations of the zth comment level of the jth secondary indicator under the ith primary indicator among experts, students, and teachers, respectively, and m is the number of questionnaires for experts, students, and teachers. Number ijzr is the membership degree of the ijC index to the fuzzy subset of zV.

Such relationship matrix iR between the second-level indicators and the first-level indicators comments for levels and q second-level evaluation indicators, then the fuzzy relationship matrix iR of the first-level indicators is shown in formula (11):

$$R_i = \begin{bmatrix} r_{i11} & r_{i12} & \cdots & r_{i1p} \\ r_{i21} & r_{i22} & \cdots & r_{i2p} \\ r_{i31} & r_{i32} & \cdots & r_{i3p} \\ \cdots & \cdots & \cdots & \cdots \\ r_{iq1} & r_{iq2} & \cdots & r_{iqp} \end{bmatrix} \tag{11}$$

According to the index weight iC and the relationship matrix iR of them, as shown in formula (11), where ijzr to the fuzzy subset of zV, and the row is calculated. The vector iB is shown in formula (12):

$$B_i = C_i \circ R_i = \left(c_{i1}, c_{i2}, \cdots, c_{iqi} \right) \tag{12}$$

The target of iB of n first-level indicators, as shown in formula (13):

$$R = \begin{bmatrix} B_1 \\ B_2 \\ B_3 \\ \cdots \\ B_n \end{bmatrix} \tag{13}$$

Comprehensive Evaluation Results

1. Weights and similar intermediate variable B are shown in formula (14):

$$B = C \circ R = C \circ \begin{bmatrix} C_1 \circ R_1 \\ C_2 \circ R_2 \\ \cdots \\ C_K \circ R_K \end{bmatrix} = \left(b_1, b_2, \cdots, b_P \right) \tag{14}$$

2. kb k = ΛP of middle school English classroom teaching.
3. Normalize kb to obtain the formula 'kb, as shown in (15).

$$b_k' = \frac{b_k}{\sum_{k=1}^{P} b_k} \tag{15}$$

4. According to formula (15), the evaluation value can be calculated, namely: w value, and then the evaluation level of middle school English classroom teaching can be obtained. As shown in formula (16):

$$w = b_k' \times v^T \tag{16}$$

EXPERIMENTAL RESULTS AND ANALYSIS

Time Distribution of English Teachers' Teaching Behavior in Junior High School

In order to better discover the coverage rate of each dimension of junior high school English teachers' teaching behavior, the authors made interval statistics on the data table of coverage rate statistical results obtained in Chapter 3 and divided the data results obtained by NVivo 11 into five range standards. The coverage rate ranges are less than 5%, between 5% and 10%, between 10% and 15%, between 15% and 20%, and more than 20%, so as to analyze the proportion of each teaching behavior structure.

The statistical results for most of behavior coverage six teachers was within the range of 15%, of which the silent support behavior (coded SS) and the dialogue question-and-answer behavior (coded DD) had the most coverage, which was much higher than 15% For example, the T2 teacher's silent support behavior (coding SS) coverage time reached 36.37%, and the T1 teacher's dialogue question-and-answer behavior (coding DD) coverage time reached 26.58%. Figure 3 shows the statistical results of the teaching behavior coverage intervals of six English teachers.

Among the four presentation behaviors of T2 teachers, there was no significant difference in time coverage. In addition to the action presentation (coded PA), the other three presentation behaviors remain within the range of 5% - 10%, but there are significant differences in the number of coded reference points.

Observing Figure 4, the number of coding reference points was the blackboard writing presentation (coded PC), and the most was the language presentation (coded PN), but the percentage of their teaching behavior duration coverage remained basically the same, which means that T2 teachers were writing on the blackboard writing presentation (In the process of coding PC). The total number of blackboard writing was small, but the time for each blackboard writing was very long. Observing the T2 teacher's action presentation behavior (coding PA), it was found that the number of coding reference points and the percentage of duration coverage were quite different. The number of coding reference points reached 24, but the percentage of duration coverage was lower than 5%, which indicates that The T2 teacher's action presentations (encoded PA) occurred with high frequency, but each time was short in duration. Compared with T1 teachers, the difference between T2 teachers in these two situations mainly depended on the presentation form of teachers' teaching activities, and there was a big difference in teaching methods between T1 teachers and T2 teachers.

Figure 3. T1-T6 teachers presenting behavior duration coverage percentage stacking chart
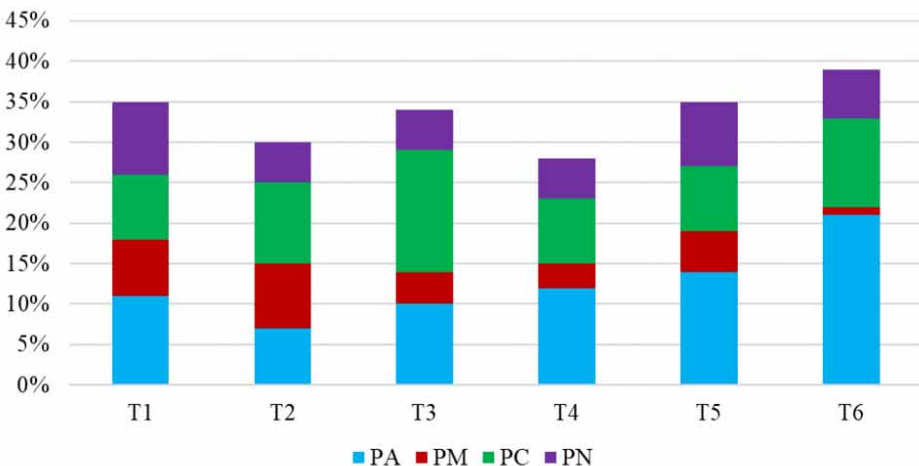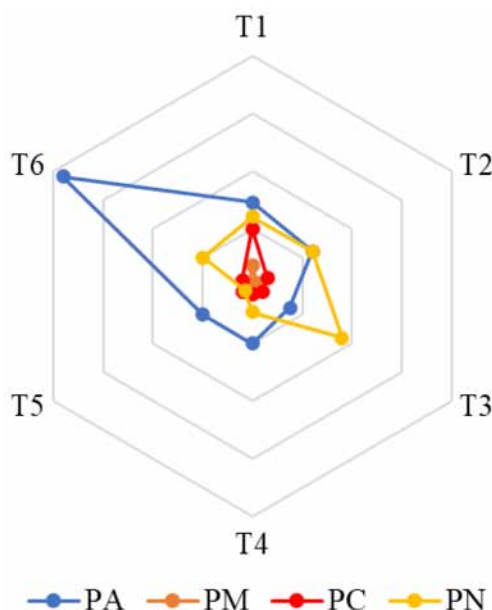
Figure 4. T1-T6 teachers present behavioral coding reference points

Correlation Between English Teaching Effect and E-TPACK Structural Elements

First of all, in terms of the E-TAPCK structural elements of English teachers, among the five teaching behaviors of the sample teachers, the E-TPACK structural elements were most frequently used for subject content knowledge (E-CK), technical knowledge (E-TK), Technology-integrated English Pedagogical Knowledge (E-TPK). Technology-integrated Subject Content Knowledge (E-TCK) were used on average six times per teacher and at least one time. Comparatively speaking, the application of English teaching method knowledge (E-TPCK), English teaching method knowledge (E-PK), and English teaching method knowledge (E-PCK) of English teachers' integrated technology was relatively lacking.

As can be seen from Figure 5, there were two obvious differences in the use of E-TPACK structural elements. One was the technical knowledge (E-TK) that was centered on the use of technology, and the English pedagogical knowledge (E-TPK) that integrates technology, integrated Technology Subject Content Knowledge (E-TCK). Another one was English Teaching Method Knowledge (E-PK) and English Subject Teaching Method Knowledge (E-PCK) with teaching method as the core, and rans through the integration technology of English teachers. The two boundaries of English Teaching Method Knowledge (E-TPCK) provided a reference basis for exploring the combined use of teachers' skills and teaching, that is, teachers cannot achieve the integrated development of information technology and teaching methods.

Effective discussion and practice require effective teaching guidance from teachers. For this reason, teachers' guidance behaviors were embodied in two forms: practice guidance (coding GP) and activity guidance (coding GA), as shown in Figure 6.

According to the total score of the importance of each indicator, a line graph is drawn representing it in Figure 7.

With such line graph in Figure 7, the X-axis of the abscissa represents the indicator items, and the Y-axis of the ordinate represents the total score of the indicator. From the analysis of the results, it can be seen that most people thought that some indicators have high total scores,

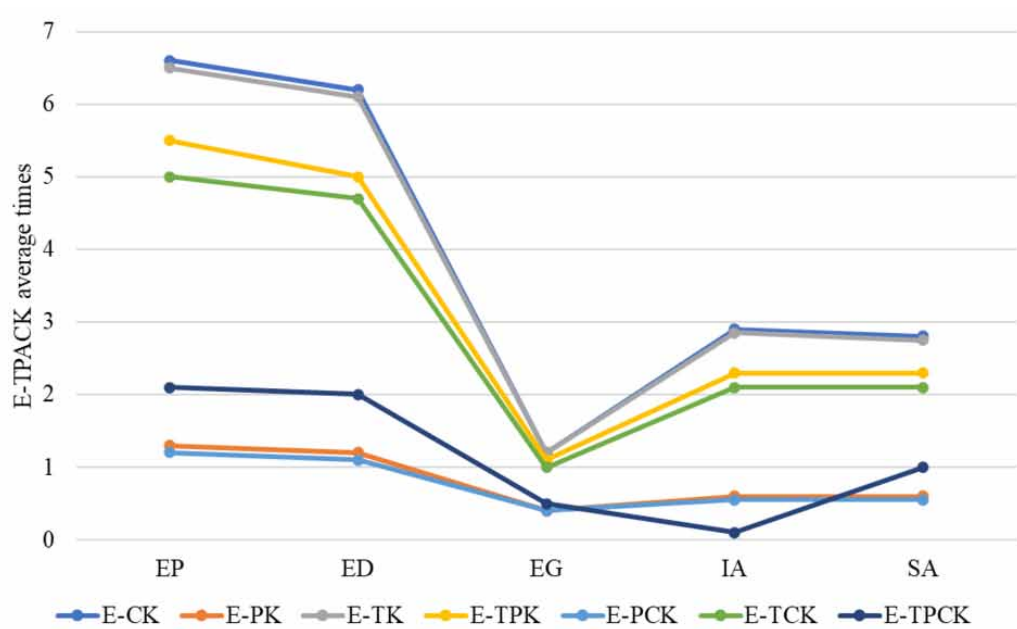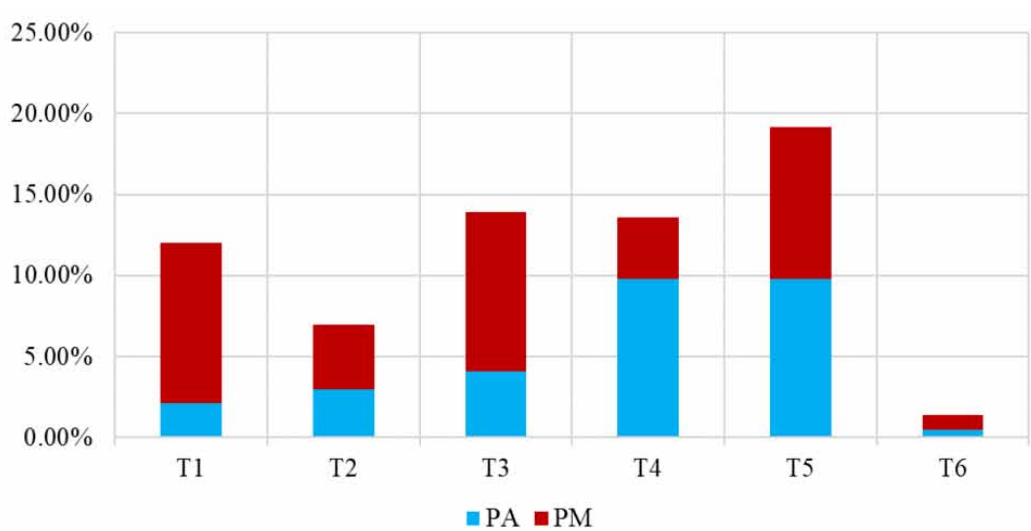**Figure 5. English teaching effect evaluation chart**

Figure 6. Analysis of the effect of teacher guidance on learning

and the scores were basically distributed over 220 points, but some indicators had relatively low scores, all below 100, so the indicators were chosen with a distribution of more than 220 points. The index is used as a reserved index, and the obtained indicators include teaching plan, scientific and reasonable classroom teaching, appropriate adjustment of teaching plan, ensuring timed completion, teaching methods, using multimedia teaching and explanation, focusing on

Figure 7. Line graph of criticality of teaching effect indicators
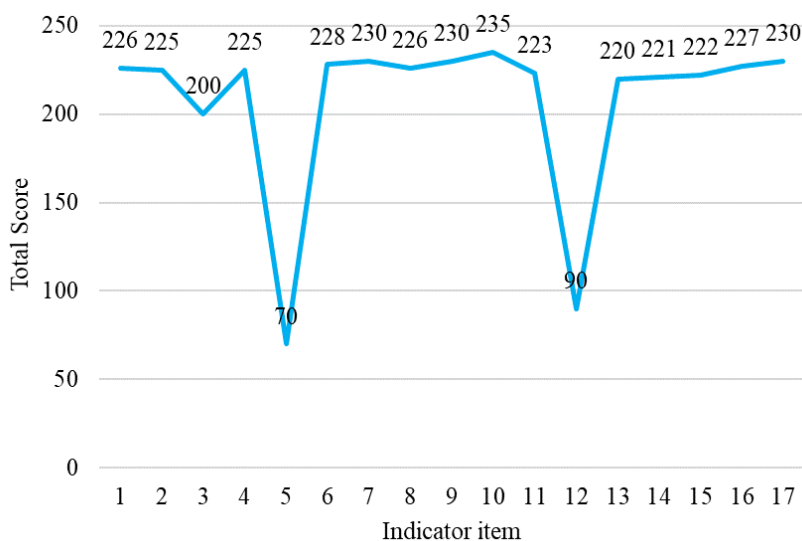
students' listening, speaking, reading and writing skills, comprehensive improvement, and classroom settings. The content of the lecture is in line with the English syllabus of the middle school, and the teaching content is positive. The lecturer can timely feedback the questions raised by the students.

CONCLUSION

Based on computational neural model simulation, this paper discusses the application of multivariate video analysis in English teaching effect evaluation, which can be used to improve the teaching evaluation system and solve challenging machine learning problems. The effect of classroom teaching focuses on teachers' teaching methods, teachers' attitude, and the ability of independent learning built by teachers and students. By extensive review algorithms, the multivariate video analysis method used in this paper is used to calculate the effect. Effect evaluation provides new evaluation ideas, and this method can also be used in other aspects of evaluation problems. Video observation and content analysis are used to make a "quantitative-qualitative" analysis of English teachers' teaching behavior reflected in English classroom teaching videos, and to accurately describe, analyze, and summarize the characteristics of English teachers' teaching behavior from various aspects. In this paper, there are still some deficiencies in using intelligent algorithms to reduce the calculation error of data in the evaluation process, which has a certain impact on the overall evaluation rate. In the complex teaching evaluation environment, in order to increase the rationality of the evaluation model, relevant personnel need to constantly adjust the English assessment objectives to provide reference for the innovation and application of the subsequent teaching evaluation model, which is the future work.

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CONFLICTS OF INTEREST

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