

# Analysis of the Effectiveness Evaluation of College Ideological and Political Course Teaching based on closed Frequent Pattern Mining Algorithm

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## Abstract:

The construction of a scientific and rational evaluation system of teaching effectiveness is an essential part of the reform of ideological and political theory courses in colleges and universities. At present, there are still some problems in evaluating the effectiveness of ideological and political theory courses in colleges and universities. It is necessary to adhere to the principle of the political, scientific and operable unity in the evaluation and the trinity of knowledge, skills, and values to carry out analysis based on the combination of qualitative and quantitative evaluation. To improve the accuracy of frequent pattern mining in a workflow environment, a new closed frequent pattern mining algorithm is proposed. Firstly, the definition of the dependency matrix is extended, that is, the workflow mining is used to establish dependency support degree matrix that contains direct dependency and overlapping relationship. Subsequently, the CHARM algorithm is extended to perform automatic mining of the closed frequent activity sets based on the support matrix. Finally, the closed frequent item sets are processed to form the final closed frequent pattern. The algorithm has a superior capacity in treating parallel and selective relations to similar algorithms. The evaluation of the effectiveness of ideological and political theory courses should be considered from the multiple dimensions such as the teaching behavior of teachers, the learning behavior of students, the teaching environment, the teaching management, and other dimensions.

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## I. INTRODUCTION

The evaluation of the teaching effectiveness of ideological and political theory courses in colleges and universities refers to the process of evaluating the teaching process and results of ideological and political theory courses comprehensively based on the specific standards, procedures and technical means <sup>[1-2]</sup>, and then making value judgments accordingly. The evaluation of teaching effectiveness of ideological and

political theory courses is not only a kind of knowledge evaluation but also a value evaluation process. The reason is that the implicitness of thought, the delay of changes in student quality, and the complexity of the influencing factors have made it highly challenging to measure such value evaluation with the specific indicator factors and precise methods <sup>[3-4]</sup>.

Since Agrawal et al. first proposed to the application of the workflow system for the

mining of the workflow model, workflow mining research has attracted the attention of more and more scholars [5]. There are two critical issues in workflow mining research: the construction of the workflow model and the frequent pattern mining. In the workflow model reconstruction, the workflow model is mainly reconstructed by studying the existing mining records of the enterprise. In a series of workflow model reconstruction algorithms, the algorithm “a” proposed by Alast and his research team is the most famous. Frequent pattern mining is another critical issue in the field of workflow mining. It is a valuable tool to present the logical relationship between the activities. At present, scholars have carried out very few studies in the field of frequent pattern mining [6-7]. The sequential pattern mining method is put forward. In the method, the Aprio-ri algorithm is used for the mining of the largest sequence in the workflow instance greater than the predefined threshold as the frequent pattern. The window principle is applied to identify the sequence set [8]. The concept of frequent pattern mining is put forward for the first time, and the sequence mining technology is used to analyze and perform mining on the frequent activity execution sequences contained in records. In this work, each activity is taken as an atomic event without considering the execution interval of the activities [9-10].

The evaluation of employers on the ideological and political qualities of students in the process of employing people is neglected. To address this issue, a new method for mining closed frequent patterns in a workflow environment is put forward based on the work of previous scholars. The main work is as the following: Firstly, the closed frequent pattern mining algorithm CHARM based on the traditional transactional database makes it suitable to perform mining of the frequent activity patterns based on the directed graph representation in a workflow environment. Secondly, the direct dependency and overlapping relationships between the

activities are used to establish an activity relationship matrix. In this paper, a scientific and rational effectiveness evaluation system of ideological and political courses in colleges and universities that can truly play a role in “facilitating correction by evaluation, promoting construction by evaluation”.

## II. BASIC DEFINITION

### 2.1 Mining Model

In system mining, the actual workflow execution of the system is recorded. The multiple tasks to be executed in the process are defined in the modeling of the workflow. The specific execution of a task is referred to as an activity, which is the basic component unit of the workflow model.

**Definition 1 (Activity)** Let Task be a finite non-empty set of all tasks, Time be a time domain. Activity set  $A = \{a | a = (task, t_s, t_e)\}$ ,  $task \in Task$ ,  $t_s \in Time$ ,  $t_e \in Time$ ,  $t_s < t_e$ . Among them, task stands for the task corresponding to the activity,  $t_s$  stands for the start time of the activity,  $t_e$  stands for the end time of the activity, and  $t_s < t_e$ . The three components of the tuple  $a$  are represented by  $a.task$ ,  $a.t_s$  and  $a.t_e$ , respectively.

**Definition 2 (Workflow Trace)**  $\sigma$  is used to represent the trajectory of a workflow. In this paper, it is assumed that there is no loop in the workflow, then there is no duplicate activity in any workflow trajectory.  $\sigma$  has recorded the execution time for each activity in the execution of the workflow.  $\sigma = a_1, a_2, \dots, a_m \in A^+$ , for  $1 \leq i < j \leq m$ ,  $a_i.t_s < a_j.t_s$  can be obtained. In addition,  $\sigma$  stands for the number of activities executed in the workflow trajectory, and  $AS(\sigma)$  stands for the activity set in the workflow execution trajectory.  $W \subseteq A^+$  stands for the workflow mining, and  $\sigma^{(i)}$  stands for the i-th workflow running trajectory in the mining W.

## 2.2 Activity Dependency Relationship

Define 3 (Priority) The activity  $a_i$  has the priority over the activity  $a_j$ , if  $\exists \sigma \in W$ , for  $1 \leq i \leq j \leq |\sigma|$ ,  $a_i.t_e < a_j.t_j$ , and  $\neg \exists a_k \in \sigma, a_i.t_e < a_k.t_s < a_k.t_e < a_j.t_s$ .

Definition 4 (Direct dependency) If  $\forall \sigma \in W$ , the activity  $a_i$  has the priority over the activity  $a_j$ , then it is referred that the activity  $a_j$  is directly dependent on the activity  $a_i$ .

From definition 4, it can be known that the direct dependency is correct only when the priority relationship of the activity  $a_i$  over the activity  $a_j$  is established on the entire mining set. At this point, there is a directed edge pointing from  $a_i$  to  $a_j$  in the workflow model represented by the directed graph, which is denoted as  $a_i \rightarrow a_j$ .

Define 5 (Overlapping) The activity  $a_i$  and the activity  $a_j$  have an overlapping relationship, if  $\exists \sigma \in W$ ,  $a_i, a_j \in \sigma$ , and  $a_i.t_s \leq a_j.t_s \leq a_i.t_e \vee a_j.t_s \leq a_i.t_s \leq a_j.t_e$ .

Definition 6 (Parallel) There is a parallel pattern between the activity  $a_i$  and the activity  $a_j$ , if and only if  $\exists \sigma^{(i)} \in W$ ,  $a_i \in \sigma^{(i)}$ ,  $a_j \in \sigma^{(i)}$ , the activity  $a_i$  take precedence over the activity  $a_j$ , and  $\exists \sigma^{(j)} \in W$ ,  $a_i \in \sigma^{(j)}$ ,  $a_j \in \sigma^{(j)}$ , the activity  $a_j$  take precedence over the activity  $a_i$ , or  $\exists \sigma^{(k)} \in W$ , the activity  $a_i$  and the activity  $a_j$  have an overlapping relationship, which denoted as  $a_i \square a_j$ .

Without considering the time at which the parallel relationship between the activities begins, it is apparent that  $a_i \square a_j \Leftrightarrow a_j \square a_i$ .

## 2.3 Frequent Pattern

Definition 7 (Pattern) The pattern  $P = (V, F)$  is a directed graph. If  $\exists \sigma \in W$ , let  $P$  be a subgraph of the directed graph corresponding to  $\sigma$ , then it is referred that  $\sigma$  supports a workflow graph  $P$  represented by a directed graph, which is denoted as  $P \uparrow \sigma$ .

Definition 7 A workflow pattern is represented in the form of a graph. Hence, the process of mining frequent activity patterns in a workflow environment is equivalent to the process of identifying frequent subgraphs in a workflow diagram. The definition of frequent activity patterns is given as the following.

Definition 8 (Frequent pattern)  $W$  stands for the set of all workflow trajectories in the workflow mining,  $\min\_sup$  stands for a real number between the intervals  $[0, 1]$ . Pattern  $P$  is frequent, if and only if  $\sup(P) \geq \min\_sup$ , in which the support degree of the pattern

$$\sup(P) = \frac{|\{\sigma : \sigma \in W, P \uparrow \sigma\}|}{|W|} \times 100\%.$$

The concept of the closed frequent pattern has also proved the equivalence between mining the complete sets of frequent patterns and mining the closed frequent patterns. The closed frequent pattern can improve mining efficiency, reduce the mining time, and reduce system overhead. In this paper, the mining of the closed frequent pattern in the workflow environment is carried out.

Definition 9 (Closed frequent pattern) If the pattern  $P'$  is a closed frequent activity pattern, there must be no such pattern  $P$  that (1) makes  $P'$  be a subgraph of  $P$ ; (2) the execution trajectory that supports any pattern  $P'$  also supports the pattern  $P$ ; in addition,  $\sup(P') \geq \min\_sup$ .

## III. MINING PROCESS OF THE FREQUENT PATTERN

### 3.1 Data Preprocessing

There are a large number of duplicated workflow trajectories in workflow mining. In

order to reduce the volume of data processed in the subsequent mining process and improve the efficiency of mining, in the first step of data preprocessing, these recurring running trajectories are filtered out. As the algorithm focuses on the sequence of the start and end events of each activity in the execution trajectory instead of the specific start and end events, in the second step of data preprocessing, each execution trajectory in the mining after the filtration is represented in the following form:

$$\sigma^{(i)} = \{a_1.t_s, a_2.t_s, a_1.t_e, a_3.t_s, \dots, a_i.t_s, a_j.t_s, a_i.t_e, \dots, a_m.t_s, \dots, a_m.t_e\} \quad (1)$$

In the third step, it is necessary to divide the workflow trace set  $W_0$  obtained in the second step into multiple subsets  $W_1, W_2, \dots, W_m$  to meet the case that if there is any  $\sigma^{(i)} \in W_i$  in  $\forall W_i$ , then  $\forall \sigma^{(i)} \in W_i$ , and  $AS(\sigma^{(i)}) = AS(\sigma^{(j)})$  can be obtained. In addition,  $W_0 = W_1 \cup W_2 \cup \dots \cup W_m$ . In the subsequent mining process, the corresponding DO matrix is established for each  $W_i$ , and a list of DO matrices  $DO = \{DO_1, DO_2, \dots, DO_m\}$  can be obtained.

### 3.2 Mining of Closed Frequent Activity Set

In this paper uses, the extended CHARM algorithm is used to perform mining on the frequent activity sets. Different from the Apriori-like algorithm, the CHARM algorithm applies a vertical data representation form, that is, each item is related to a set of identifiers. In the workflow environment, the identifier set refers to the set of workflow running track numbers containing the item. The algorithm performs mining on all the closed frequent activity sets on the IM-Tree (Itemset-Midset Search Tree). Each node on the IM-Tree is represented as a binary group  $X \times M(X)$ , in which  $X$  stands for a set of items, and  $M(X)$  stands for a set of the workflow running track numbers containing the item set  $X$ .

In the extended CHARM algorithm, the DO matrix is used as a model to carry out the frequent activity pattern mining. The algorithm uses the priority and overlap relationship between the activities as the 1-item set, that is, the following can be obtained.

$$1\text{-itemset} = \{d_y | d_y > 0, d_y \in DO_{k-LL, t, i} < j\} \cup \{p_{mn} | p_{mn} < 0, p_{mn} \in DO_{k-LL, t, m} < n\} \quad (2)$$

The support degree of each item is calculated according to definition 8. The item larger than the minimum support degree threshold is the frequent 1-item set. The frequent 1-item set is arranged in ascending order according to the sum of the support degree in the 2-item set containing the item, which constitutes *f-list*.

## IV. EXISTING PROBLEMS IN THE EVALUATION OF THE EFFECTIVENESS OF THE IDEOLOGICAL AND POLITICAL THEORY COURSE TEACHING

At present, there are still some problems in the practice level of ideological and political theory course teaching in colleges and universities.

Firstly, the uniqueness of the ideological and political theory courses is not fully considered. At present, in the practice of course quality evaluation in colleges and universities, the evaluation indicators for the ideological and political theory courses are basically the same as those of the basic courses and professional courses in other disciplines, and there is no specific distinction. The evaluation objectives and indicator systems fail to reflect the characteristics of the ideological and political theory courses themselves in colleges and universities, which lead to the result that the evaluation is not highly targeted, and the unique connotation of teaching in different disciplines is obscured at the same time. Secondly, in the content of the “teaching and learning” link, the evaluation of “knowledge and conduct” is neglected due to the constraints of many factors, and there is the phenomenon of valuing the results while



neglecting the processes. Compared with other courses where the knowledge teaching is taken as the main goal, the teaching goal of ideological and political theory courses is not only to impart knowledge but more importantly, to lead and educate the ideology. Hence, the evaluation of the ideological and political theory teaching should not be simply an intellectual evaluation, but an evaluation of values or concepts. That is to say, the teaching evaluation of ideological and political theory courses in colleges and universities should not only include the “teaching and learning” link but also consider the deeper “knowledge and conduct” links. Although some colleges and universities have realized that they should pay more attention to investigate the “knowledge and conduct” level, due to the limitation of the fuzzy abstraction of evaluation criteria, the specific evaluation results in practice also have relatively great limitations. In addition, the existing teaching evaluations are mostly based on the results of the mid-term or final exams at the specific time nodes. They are “cut-off” descriptions after they are “truncated”, focusing on the results while rarely relying on the process. Thirdly, the simplification of the evaluation method. At present, the main body of the evaluation of ideological and political theory courses in colleges and universities is the competent department of education at all levels in colleges and universities in general. The main method adopted is to collect multiple feedbacks from the students in the form of questionnaires, supplemented by the school leaders, curriculum experts, and peer teachers by means of listening to the class teaching..

#### V. PRINCIPLES FOR EVALUATING THE EFFECTIVENESS OF IDEOLOGICAL AND POLITICAL THEORY COURSE TEACHING

To evaluate the effectiveness of the ideological and political theory teaching, it is necessary to clarify or construct a highly oriented evaluation concept, determine the specific evaluation criteria, and refine the

standard as an operational indicator system to detect the goal, the value of teaching, and the extent of implementation in the ideological and political theory courses. adhere to the principle of unification of political, scientific, and operability in the evaluation. Although the ideological and political theory course has the characteristics of knowledge, academics, and social practice, the political and ideological nature is its essential attribute. This characteristic determines that the evaluation system for its teaching effect should focus on the knowledge and skills that are different from the evaluation system for the other social science courses. In addition to examining the specific knowledge, methods and skills of students, college ideological and political theory courses should pay more attention to the investigation of the world outlook, behaviors, and values of the students. Secondly, insist on the comprehensive assessment principle of knowledge, skills, and values. The evaluation standard for the effectiveness of ideological and political theory courses is an objective value measure to determine the effectiveness of ideological and political theory courses and is the key to the evaluation of curriculum effectiveness.

#### VI. PRACTICAL EXAMPLE ANALYSIS OF THE EFFECTIVENESS EVALUATION OF IDEOLOGICAL AND POLITICAL THEORY COURSE TEACHING

The evaluation of the teaching effectiveness of ideological and political theory courses should be designed from the intrinsic connection of teaching factors and the formation mechanism of teaching quality. In terms of the content of teaching, it is a system; in terms of the timing of teaching, it is a process. Hence, the teaching system, process, and related influencing factors should be assessed in the evaluation of teaching. The relevant theories on effective teaching are investigated, and it is necessary to focus on not only the cognitive development of the evaluation criteria for the effectiveness but also the development of the personality.

Figure 1 shows the workflow model of ideological and political course teaching in a university. In this paper, the mining set consistent with the traditional algorithm is used to conduct the frequent pattern mining test. The minimum support threshold  $\min\_sup = 0.4$ . The algorithm execution process is shown as the following.

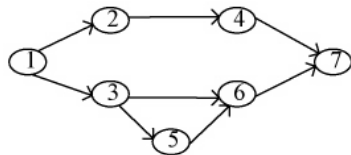


Figure. 1 Customer complaint workflow model

Step 1 The set of running tracks after the pretreatment according to the method in Section 4.1 is as the following:

$$\sigma^{(1)} = \{a_1^s, a_1^e, a_2^s, a_3^s, a_2^e, a_4^s, a_3^e, a_5^s, a_4^e, a_5^e, a_6^s, a_7^s, a_7^e\}$$

$$\sigma^{(2)} = \{a_1^s, a_1^e, a_2^s, a_3^s, a_3^e, a_2^e, a_4^s, a_5^s, a_6^s, a_4^e, a_6^e, a_7^s, a_7^e\}$$

$$\sigma^{(3)} = \{a_1^s, a_1^e, a_3^s, a_2^s, a_3^e, a_6^s, a_2^e, a_4^s, a_4^e, a_6^e, a_7^s, a_7^e\}$$

$$\sigma^{(4)} = \{a_1^s, a_1^e, a_2^s, a_3^s, a_3^e, a_6^s, a_6^e, a_2^e, a_4^s, a_4^e, a_7^s, a_7^e\}$$

$$\sigma^{(5)} = \{a_1^s, a_1^e, a_2^s, a_3^s, a_3^e, a_5^s, a_6^s, a_2^e, a_4^s, a_6^e, a_4^e, a_7^s, a_7^e\}$$

Step 2 The direct dependency and overlap relationships contained in each trajectory are extracted according to definition 4 and definition 5, and the active trajectory is expressed in the form as the following:

$$\sigma^{(1)} = \{d_{12}, d_{13}, d_{24}, d_{35}, d_{56}, d_{67}\} \cup \{p_{23}, p_{34}, p_{47}\}$$

$$\sigma^{(2)} = \{d_{12}, d_{13}, d_{35}, d_{24}, d_{56}, d_{67}\} \cup \{p_{23}, p_{25}, p_{56}\}$$

$$\sigma^{(3)} = \{d_{13}, d_{12}, d_{36}, d_{24}, d_{47}, d_{67}\} \cup \{p_{32}, p_{26}, p_{67}\}$$

$$\sigma^{(4)} = \{d_{12}, d_{13}, d_{36}, d_{64}, d_{24}, d_{47}\} \cup \{p_{23}, p_{26}\}$$

$$\sigma^{(5)} = \{d_{12}, d_{13}, d_{35}, d_{24}, d_{56}, d_{67}, d_{47}\} \cup \{p_{23}, p_{25}, p_{26}, p_{64}\}$$

Step 3 According to definition 10, the DO matrix can be obtained as the following:

$$DO_1 = \begin{matrix} a_1 \\ a_2 \\ a_3 \\ a_4 \\ a_5 \\ a_6 \\ a_7 \end{matrix} \begin{bmatrix} 0 & 3 & 3 & 0 & 0 & 0 & 0 \\ 0 & 0 & -3 & 3 & -2 & -1 & 0 \\ 0 & 0 & 0 & -1 & 3 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 & -1 & 0 \\ 0 & 0 & 0 & -1 & 0 & 3 & 0 \\ 0 & 0 & 0 & -1 & 0 & 0 & 3 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

Step 4 Calculate the 1-itemset and sort the items according to the weight of each item to obtain the following:

f-list = {d36×(34), d47×(34), p45×(12), p25×(25), p26×(345), p46×(235), d35×(125), d56×(125), d67×(125), d12×(12345), d13×(12345), d24×(12345), p23×(12345)}.

Step 5 Introduce the f-list obtained in step 4 as a parameter to the function CHARM-Extened([P], C), and the closed frequent activity set obtained from the mining is arranged according to the degree of support in descending order

Step 6 The frequent activity pattern represented by the directed graph is generated, and the result is shown in Figure 2. Figure 3 shows the mining result of the traditional algorithm. The activity in the workflow model has a parallel relationship. The comparison mining results show that the algorithm proposed in this paper can better identify the patterns of frequent parallel relationships in the workflows.

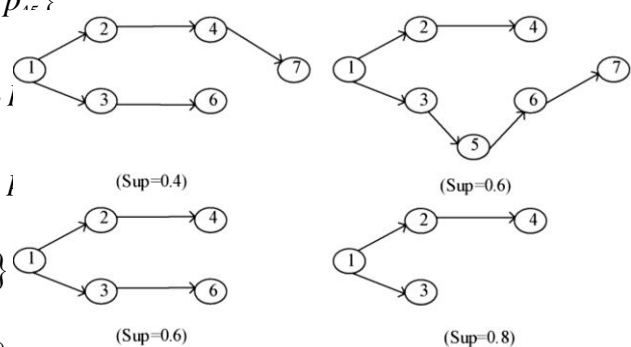


Figure. 2 Frequent activity pattern

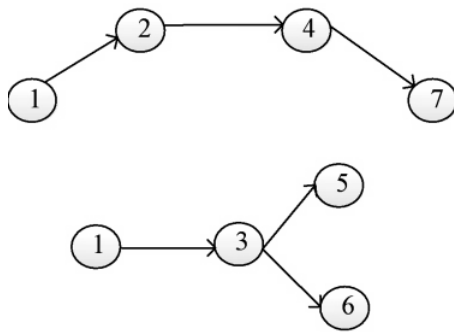


Figure. 3 Results of traditional algorithm mining

As the laws, characteristics, and expression forms of the two developments are different, effective teaching evaluation cannot be univariate but should be pluralistic. To take the various factors within the system into comprehensive consideration and determine the dimensions of teaching effectiveness evaluation, it is necessary to establish an indicator system consisting of multiple variables. In the object of teaching evaluation of ideological and political theory courses in colleges and universities, the teachers and their teaching activities, the students and their learning activities are the central links that connect many factors organically. Hence, in the construction of the evaluation indicator system for ideological and political theory courses in colleges and universities, it is also necessary to take these two aspects as the most essential evaluation items. In addition, other relevant influencing factors should be considered to establish a practical evaluation indicator system for ideological and political theory courses on this basis. Specifically, the evaluation of the teaching effectiveness of ideological and political theory courses should focus on the variables in the following dimensions:

Firstly, the teacher dimension from teaching behavior. American educator Borich believes that effective teaching includes five key behaviors as the following: firstly, clear teaching; secondly, diversified teaching; thirdly, task orientation; fourthly, guiding students into the learning process; fifthly, ensuring the learning success rate of students. As far as the teachers of ideological and

political theory courses are concerned, they are not only the disseminators of specific knowledge but also the people who guide the world outlook, outlook on life and values of the students. Hence, the evaluation of the teaching effectiveness of ideological and political theory courses should be broader, where the political orientation and scientific nature of the curriculum should be unified. Given these evaluation needs, the specific evaluation observation points can be set up from multiple latitudes such as teaching content, teaching methods, thinking power, and communication power. Thus, the corresponding indicator system can be determined.

Secondly, the dimension of the educated from learning behavior. The teaching of ideological and political theory courses in colleges and universities should mainly focus on the values, methodology, knowledge level and other aspects of contemporary college students. As the study subject, the students participate in the whole teaching process of the ideological and political theory course and have a personal feeling and experience for the teaching effect of the courses. Hence, they have the most informed right and discourse right on the specific teaching effect and even the value evaluation of the ideological and political theory courses. For them, the effectiveness of classroom teaching in ideological and political theory classes is shown at different levels. Knowledge and ability are fundamental goals. In terms of knowledge, it is specifically expressed as the understanding of the Marxist theory; in terms of abilities, in addition to the meaning of ability in the general term, more focus is put on the political sensitivity, discernment, judgment, and theoretical application ability of the students. In addition, whether there is a correct attitude towards learning, whether they have positive emotions, whether they can maintain a high degree of resonance with theoretical self-confidence, and whether they can participate in social practice are also part of the effectiveness evaluation of ideological and political theory courses. It is generally

believed that the evaluation of teaching effectiveness is mainly aimed at both teachers and students. However, compared with teachers, students are more critical, and the assessment should be aimed to promote the development of students. In the investigation of students, attention should be paid to the observability, that is, the lowest level of evaluation indicators should be linked to the observation evidence so that the judgment of each indicator is implemented on the objective and observable evidence.

The above two parts constitute the indicator framework for the evaluation of the effectiveness of ideological and political theory courses, as shown in the following table:

First level indicator	Second level indicator		Evaluation point
Teachers	Course design		Teaching objectives
			Teaching materials
	Teaching implementation		Teaching capabilities
			Teaching depth
			Teaching attitude
			Teaching method
	Support and promotion for the students		Providing students with extended reading, which is conducive to deepening the thinking capabilities of the students
			Provide material resources, guiding the students to use resources and technology to carry out active learning
	Effective feedback and communication after class		Communication channels are available to provide students with accurate diagnosis and feedback information
			The help of homework feedback comments to students
Students	Teaching result	Cognition	The degree of awareness of Marxist theoretical knowledge, the understanding of the concepts and theories involved in the curriculum and the degree of mastery
		Skills	General written and verbal abilities
			Political sensitivity, discernment, judgment, and theoretical analysis abilities
		Emotional identity	Whether a high degree of resonance and conscious recognition have been reached with the content of the lecture
		Practice	Ability to apply the theory learned to practice
Environmental factors	Classroom environment		Classroom ecology
	Creation of teaching situations		A harmonious situation and atmosphere between the teacher and the students
Teaching management and	Teaching management		The needs of teachers are considered in the relevant management measures

In the above section, a relatively complete and operable research framework is

established preliminarily. After determining the corresponding indicators according to the above dimensions, the questionnaire can be designed to obtain the overall situation of the current teaching effectiveness of ideological and political theory courses. However, it should be recognized that the effectiveness of teaching is based on the selection of evaluation perspective and the choice of evaluation tools. Its relativity and rationality is always a question that is worth questioning and exploring. The evaluation results should be treated objectively. In addition, the implementation of the teaching effect of ideological and political theory courses has a certain time delay. How to evaluate the potential effect is also a topic that should be further studied in the future.

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