



Research on the Construction of Civic and Political System of College English Course by Integrating Q Learning Algorithm under Blended Teaching Mode

Jing Tan^{1,*}

¹ Foreign Language College, Xiangnan University, Chenzhou, Hunan, 423000, China

SUMMARY: *This paper compiles a cognitive attribute diagnostic test paper, counts students' mastery of cognitive attributes of college English course Civics and compares it with the ideal mastery pattern, completes the categorization of cognitive attribute mastery patterns, and constructs a hierarchical learning model. The Q-learning algorithm is used to solve the value function of different cognitive attribute learning paths to determine the learning path that has the best effect in improving the value of learning ability, and to assist teachers in improving the quality of Civics and Politics blended teaching in college English courses. The cognitive attribute mastery patterns of 200 students are 100% compatible with the 19 ideal mastery patterns, and the Civics and Politics cognition of students is in a reasonable range. Students' cognitive attribute learning ability and Civics level.*

KEYWORDS: *cognitive attributes; Q-learning algorithm; learning path; college English; blended teaching of Civics and Politics in courses*

1 Introduction

Colleges and universities play an important value in the improvement of students' comprehensive quality and the improvement of students' overall ideological level. The penetration of the ideological teaching program in college courses can promote the continuous improvement of the educational ideological teaching system in colleges and universities, and is of great value to the deepening of the moral education project in higher education [1, 2]. College English as a general education course in colleges and universities, its curriculum in the construction process needs to be integrated and permeated with multiple cultural elements, the curriculum for the ideological education of college students has a hidden educational value and significance [3]. The theory and content of the ideological and political courses are integrated into the university English courses, which need to penetrate into the internal courses with the help of the hidden educational value of the courses, emphasize the logical relationship between the courses themselves and the ideological and political education, and construct the university English teaching courses with double integration of theory and practice [4-8]. However, the integration of the elements of ideological and political education in the current university English courses is superficial and fragmented, which is not significant for the effect of educating people [9]. The hybrid teaching mode provides a solution to this problem.

Hybrid teaching mode is a product of the development of the information age, is a special form of information technology applied to teaching, the teaching mode emphasizes the deep integration of online and offline teaching, effective innovation on the basis of the traditional

*xnxytanjing@126.com

<https://doi.org/10.65102/is2026563>

teaching mode, retaining the advantages of traditional teaching and information technology, so as to continuously improve the quality of teaching [10]. The application of blended teaching mode in college English makes teaching no longer restricted by time and space, and students can carry out learning anytime and anywhere through the network, and provides favorable conditions for students to learn extracurricular knowledge, enriches students' learning content, and provides personalized learning experience [11-13]. For teachers, the emergence of mixed teaching mode, teachers can combine the teaching content, take different teaching methods, enrich the form of teaching, stimulate students' interest, and also ensure the effect of student learning [14, 15]. This teaching mode provides a space for the integration of Civics and Politics in the university English classroom, and provides a path for the construction of Civics and Politics system in the university English program. However, under the blended teaching mode, the personalization of Civic and Political teaching in college English classroom is insufficient, the integration of Civic and Political elements is not complete, and an effective assessment system has not been established [16-18]. Based on this background, the study of optimizing the construction of the Civic and Political system of university English courses in the blended teaching mode is of great significance to the Civic and Political teaching of university English.

In this paper, the cognitive attributes of Civics and Politics in college English courses are divided into different levels by stratification according to the order of mastery. A cognitive diagnostic test paper with good differentiation is used to investigate the mastery level of students' cognitive attributes of Civics and Politics in college English courses. According to the cognitive attribute mastery situation, students' cognitive mastery patterns are categorized, and the Q-learning algorithm is used to explore the optimal strategies for selecting different learning paths, so as to maximally iterate the learning paths with high return values as the recommended paths. The recommended learning paths are used as references for the setting of the blended teaching system of Civics and Politics in college English courses to provide students with differentiated learning guidance.

2 Construction of hybrid teaching system for courses supported by Q-learning algorithm

2.1 Theoretical foundations of Q-learning algorithms

Q learning algorithm is developed from the theories of animal learning, stochastic approximation and optimal control, which seeks the optimal policy by estimating the value function $Q(s_i, a_i)$ for the state-action pairs, and it is a kind of reinforcement learning algorithm accomplished through the learning of the value function of the actions, where $Q(s_i, a_i)$ is the cumulative payoff value obtained by performing action a_i in the current state s_i . The learning algorithm selects action a_i from the given set of actions under the given state s_i according to the set of exploration rules, and after each action, the intelligent body Agent will provide reward or punishment information based on the new state after the completion of the action to determine whether this exploration action is correct or not. After the completion of the action, the desired reward value rew is calculated based on the reward or punishment information, the Q value table $Q(s_i, a_i)$ and the state of the Intelligent Body s_i are updated, and then the loop iteration is repeated until the setup of the end rule. By learning from this non-direct, delayed reward, the subsequent actions produce the maximum cumulative effect, and the strategy with the maximum cumulative effect is the optimal strategy.

Then the optimal strategy can be expressed as:

$$\pi^* = \arg \max_{a_i} Q(s_i, a_i) \tag{1}$$

The value function $Q(s_i, a_i)$ of a state-action pair is iteratively updated by the formula:

$$Q(s_i, a_i) = Q(s_i, a_i) + \alpha \times [rew(s_i, a_i) + \gamma \times \max_a Q(s_{i+1}, a) - Q(s_i, a_i)] \tag{2}$$

where $Q(s_i, a_i)$ is the iteratively updated value function, α is the learning factor, and γ is the discount factor.

Figure 1 shows the structure of the Q learning algorithm.

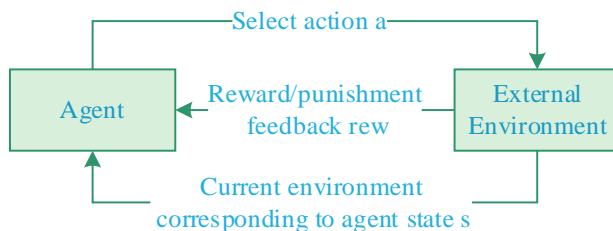


Figure 1: The structure of the Q-learning algorithm

Figure 2 shows the flow of the Q learning algorithm. The specific steps of the Q learning algorithm are shown below:

1) Initialization: including the system environment, each parameter, and the Q value table, determine the state of the algorithm, the action, the exploration strategy, the termination condition and so on;

2) Observe the current state s_t of the intelligent body, determine the action a_t and execute it according to the action selection strategy, and the environment returns rew immediately based on the feedback of the action's merit;

3) Iteratively update the current value function $Q(s_t, a_t)$ according to the iterative update formula (2) and update the current state of the intelligent body;

4) Determine whether the current state of the intelligent body meets the termination conditions, if so, the algorithm ends; otherwise, go back to the second step and repeat the execution of steps 2-4.

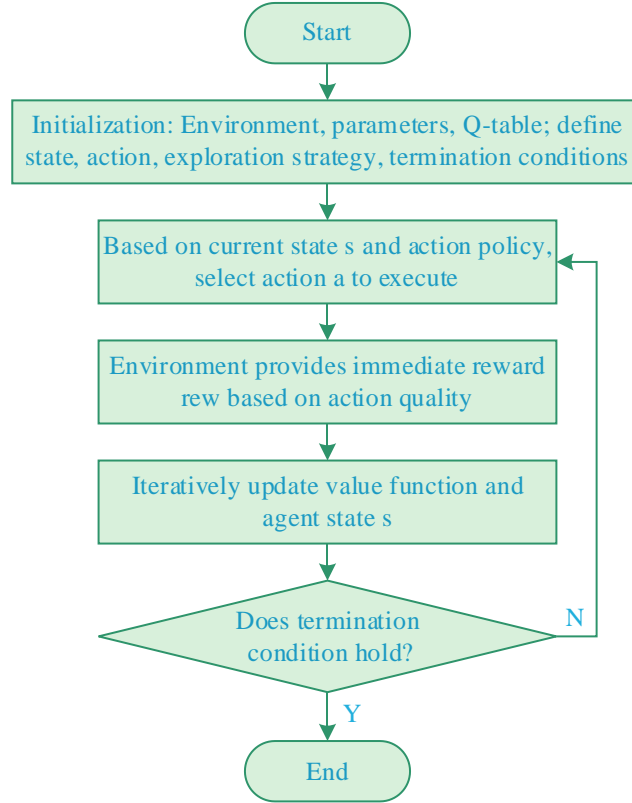


Figure 2: The Q learning algorithm flow chart

2.2 Q learning path construction under cognitive hierarchy

2.2.1 Hierarchical Learning Models

The Attribute Hierarchical Method (AHM)-based cognitive item response model is used to deal with situations in which cognitive attributes are hierarchically independent and correlated, and in particular for the sequencing of cognitive abilities needed to solve a test problem. Four structures are included in the approach: linear, convergent, divergent, and unstructured. All learning structures can be stratified by the attribute stratification method, in which different cognitive attributes A_n , $n=1,2,\dots,5$ are layered so that the attributes are both related and independent of each other.

Thus hierarchical structures can be modeled. There are three assumptions for two independent cognitive attributes as follows:

- 1) Assume that the cognitive attribute A_1 is the antecedent structure of A_2 ;
- 2) Each cognitive attribute has K different levels of competence;
- 3) The use of A_n^0 to indicate that the learner does not possess competence in that cognitive attribute, and A_n^1, \dots, A_n^K to indicate the K different levels of competence levels that a particular cognitive attribute possesses, $n \in \{1, 2\}$.

The following assumptions are made about the level of competence of cognitive attributes:

- 1) For the same cognitive attribute, learners can only learn high levels of competence after mastering low levels of competence:

$$P(A_n^k = 1 | A_n^{k-1} = 0) = 0 \quad k \in (2, \dots, K) \quad (3)$$

2) Cognitive Attributes Some of the competencies of A_2 can only be learned and mastered after some of the same level of competencies of A_1 have been fully mastered:

$$P(A_2^k = 1 | A_1^k = 0) = 0 \quad k \in (1, \dots, K) \quad (4)$$

3) For a learner who has mastered a higher level of competence in the antecedent structure A_1 , it is important to learn and master the same level in A_2 no less than a learner who has mastered a lower level of competence in A_1 :

$$P(A_2^k = 1 | A_1^{k+1} = 1) \geq P(A_2^k = 1 | A_1^k = 1) \quad (5)$$

After the elaboration of the relationship between two independent cognitive attributes, the hierarchical attribute structure is finished modeling.

The learner's ability level on different cognitive attributes can be assessed and structured by a cognitive diagnostic model.

In the hierarchical learning model, the hierarchical attributes are combined by constructing a state space. The hierarchical learning model can not only generate only linear structures, but also other (convergent, divergent, and unstructured) structures, but also add more stringent rule qualifications (e.g., A_2 can only start to learn after all the abilities of its antecedent attribute A_1 have been mastered).

The design of the hierarchical learning model not only consolidates the hierarchical structure of cognitive attributes, but also allows the attributes in the cognitive diagnostic model to be used at different levels of competence. Since the hierarchical learning model takes the form common in cognitive diagnostic models, it is easy to construct restricted Q matrices and easily estimate the cognitive attributes and parameters in them. The hierarchical design of the model greatly reduces the number of parameters and attributes that need to be computed in cognitive diagnostic models.

2.2.2 Learning paths based on Q-learning

After modeling through the hierarchical learning model, the Q learning algorithm of reinforcement learning is used to construct efficient learning paths for the university English course Civics. Figure 3 shows the learning path planning process. The red-colored barriers are the constraints in the learning process.

Reinforcement learning is different from machine learning in that it is model-free, so it does not require a specific model for learning, but rather, the agent interacts with the environment (here, the learning system) continuously, and in the process of interaction, the system will construct a state space table to record the agent's "trial and error" process. The system will construct a state space table to record the "trial and error" process of the agent.

During the exploration and learning process, the only actions the agent can choose are up, down, left and right. When the agent chooses action a , the environment (system) will give a reward value r , then the state space table will be updated. When the reward value is positive, the agent will choose action a with high probability next time, and vice versa when the reward value obtained is negative, it will choose action a with reduced probability, and the cycle is known to repeat until the agent reaches the end position.

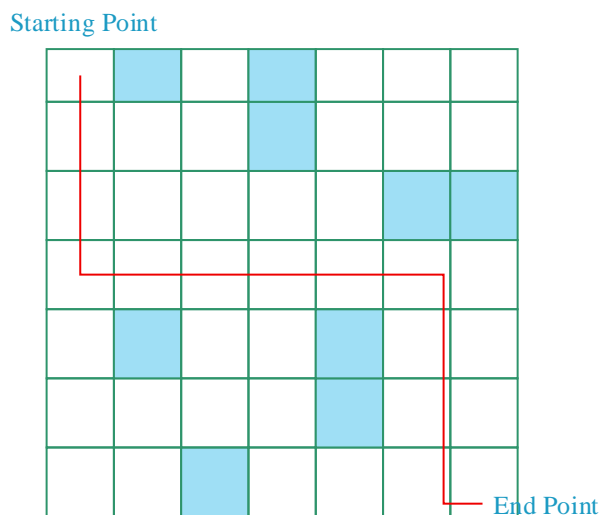


Figure 3: Learning Path Planning Process

Since reinforcement learning does not require a lot of data and labels unlike deep learning, it intervenes a lot of labor and effort. Next the learning path is modeled based on Markov decision process. All cognitive attributes $\{\alpha\}$ are defined as state space and all learning materials $\mathcal{L} = \{l_1, \dots, l_L\}$ are defined as behavioral space.

Since both the state space and the behavior space are discrete states in the algorithm, the classical algorithm in reinforcement learning can be used: the Q learning algorithm. The Q -learning algorithm uses the Q -function to estimate the behavioral values, denoted by $Q(\alpha, l)$, and the reward values in the algorithm are converted to the current step size. If the learning rate is chosen correctly and the state and behavior space is explored repeatedly, then the Q learning algorithm will converge with probability 1. In practice, however, it generally starts by exploring with ϵ probability and then continuously decays.

2.3 Instructional system for learning path planning based on Q-learning

In the construction of the blended teaching system of Civics and Politics for university English courses, teachers find differentiated optimal learning paths for different students through Q -learning algorithms based on the stratification of students' cognitive levels. After that, according to the completion degree of students' learning paths, they set up different levels of teaching objectives and content structures, and utilize various resources of blended teaching to improve students' learning level and learning interest.

2.3.1 Teaching objectives and content structure

In the process of teaching Civics in university English courses, there are always students with different bases and levels, and their teaching objectives and content structure should be different. The teaching objectives can be set as a basic standard, which is the standard that all students need to reach, and the requirements should not be too high, but should not reduce the effect of the Civics of College English Program. On top of this basic requirement, the specific standard requirements can be gradually improved according to the breadth and depth of the university English program's Civics, and the teaching objectives can be formulated at multiple levels, forming a pyramid-type structure. On the basis of considering students' subordinate skills, the

teaching content should also be based on the teaching objectives of different levels, set the corresponding scope limitations and depths, and make clear the key and difficult points.

2.3.2 Differentiated Instructional Strategies

Differentiated teaching in the Civics and Political Science Department of university English courses refers to adjusting the teaching process, methods and means according to the elements of teaching objectives, content structure, teaching environment as well as learners' characteristics to provide students with different learning paths.

1) Selection of learning paths

The teaching model described in this paper contains three internalizations before, during and after class, i.e., online learning before class, offline teaching during class and extended learning after class. In both the pre- and post-course stages of learning, students' knowledge hierarchical learning models are constructed to understand students' cognitive levels of different knowledge, and Q-learning algorithms are used in a timely manner to plan differentiated learning paths that are most suitable for students. Pre-course online learning allows students to determine the initial teaching objectives and choose the learning path that suits them according to their interests, cognition and abilities. For example, students with poor foundation and weak cognition can spend more time watching the video and learning materials of college English course Civics and completing basic exercises during pre-course online learning, while students with good foundation and strong learning ability can jump and selectively learn, comprehend deeper content and complete more difficult exercises. Teachers can choose a variety of learning paths in the blended teaching process according to the actual situation, including learning resources, exercise content, expanding practice, comprehensive application, etc., and give the reference time and effect of completing the tasks.

2) Selection of teaching methods

Teaching methods should be changed according to the progress of students' learning path completion. The blended teaching mode includes online lectures and learning before class and offline discussions and Q&A during class to enhance students' learning interest and learning effect. For students with a better learning foundation, this approach can achieve better teaching results, while for students with a weaker foundation and infrequent questions and discussions, this approach may affect their interest in learning, so this teaching method can not be set in stone in practical application. In-class offline teaching is not just discussion, it can be properly guided and directed by the teacher, explaining the ideas, key points, cases, etc., and then discussion and Q&A. And in-class discussion grouping should not be fixed, can be the same level of students into a group, or different levels of students into a group, can be based on the difficulty of the discussion topic, the level of the learner, the degree of incentive and other factors to determine.

2.3.3 Blended learning process

The task-driven blended learning process realizes three times internalization of online before class, discussion and learning during class and extension after class.

1) Pre-course online learning - “micro-video + micro-resources + micro-tests + online tutoring”

Based on the Q-learning algorithm to explore the best learning path, each knowledge point involved in the path is constructed as a complete learning task list. Driven by the task list, students complete the learning tasks based on the knowledge points in the task list, which are composed of micro-videos, micro-resources, micro-tests and online tutorials provided in the blended teaching mode, to consolidate the knowledge points they have already learned and to learn new knowledge points. Online learning before class provides space and services for

students' independent learning, mobilizes students' initiative, enthusiasm, interactivity and conscientiousness in learning, and allows students to complete the first internalization of learning.

2) Discussion and learning in class - “Cooperation + Discussion + Communication”

The mastery of each knowledge point in the learning path and the success of classroom teaching must be based on mobilizing students' motivation to learn. Classroom activities rely on online learning content, are driven by completing tasks and projects, and focus on cultivating students' sense of inquiry and innovation. In the classroom offline teaching, the teacher appropriately arranges in-class discussion of tasks and projects based on the task list and the effect and feedback of online learning before class. In the classroom, the teacher plays a coordinating and evaluating role, grading individuals and groups based on students' participation and understanding, accuracy, and fluency, respectively. Students' discussions and debates in the classroom are the process of understanding, internalizing and practicing the knowledge and skills they have learned. At the same time, students can learn to express themselves and listen through analyzing and collaborating to solve problems and exchange different points of view, thus promoting the smooth progress of blended learning and completing the second internalization of learning.

3) Expanding learning after class - “Practice + Communication + Mutual Assessment”

Teachers set practical project tasks, propose research methods and set outcome requirements according to the completion of students' learning paths; students expand their learning of relevant knowledge and methods according to their own actual situation, and complete them in learning groups through online research and discussion and offline collaborative practice; teachers can provide online tutoring based on students' feedback on the problems; students will, after completing their project outcomes Graphics, text, animation, video and other forms of display on the learning platform, mutual evaluation and exchange, through the teachers and students, students and students to evaluate each other, so that the students are in a kind of analysis of self, judging others, creating an atmosphere of application, driving the migration and application of knowledge, which strengthens the collective collaboration, complete the third internalization of knowledge.

3 Student cognitive diagnosis and learning path planning based on Q-learning algorithm

3.1 Preparation for building a hierarchical learning model based on cognitive diagnosis

3.1.1 Development of cognitive diagnostic pretest papers

In this section, before the cognitive diagnosis of students and the construction of the hierarchical learning model for all students, the acquisition of the cognitive attributes of the university English course Civics is completed, as well as the prediction and adjustment of the pre-cognitive diagnosis, to improve the scientificity of the model construction and the credibility of the subsequent experimental results.

Analyze each cognitive attribute of the Civics and Politics of College English Course (Clarification of Emotional Attitude and Values A1, Penetration of Moral Education A2, Cultivation of Teamwork Spirit A3, Attention to Hot Topics of Current Events and Focused Problems of the Society A4, Enhancement of Critical Thinking Ability A5, Enhancement of National Pride A6, and Enhancement of Patriotic Feeling A7), and arrive at the reachable (R) matrix indicating the direct relationship, indirect relationship, and self-relation among the

cognitive attributes to obtain the ideal mastery model of each cognitive attribute.

Figure 4 shows the 20 ideal mastery patterns of 7 types of cognitive attributes. From the ideal mastery patterns, it is easy to see that the mastery of the cognitive attribute of emotional attitude and values is the basis for the mastery of the other cognitive attributes, and if the students' emotional attitude and values are not clear, then it will be difficult for teachers to complete the integration of the curriculum's ideology and politics in college English teaching. Therefore, the ideal mastery mode 3 is illogical, and by eliminating this mode, there are 19 ideal mastery modes for the 7 types of cognitive attributes.

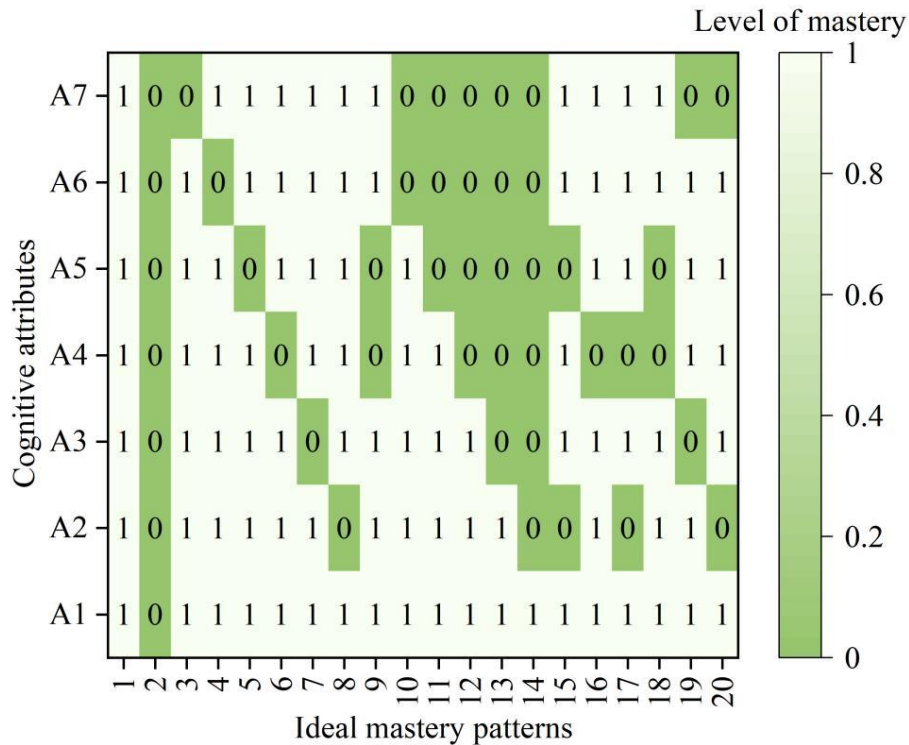


Figure 4: 20 different ideal mastery patterns of the 7 types of cognitive attributes

A Q matrix was developed by preparing rational test items based on the cognitive attributes that had been identified, associating the cognitive attributes with the items, and coding the attributes contained in the items to establish a link between the cognitive attributes and the items.

Figure 5 shows the initially established Q matrix. A “1” means that the item examined a cognitive attribute, and a “0” means that the item did not examine this cognitive attribute. The 21 cognitive attribute quiz items were developed to ensure that each cognitive attribute was examined at least four times, and to ensure that the cognitive foundation A1 and cognitive goal A7 of the university English course Civics were examined in each item, so as to measure the degree of students' mastery of the course Civics.

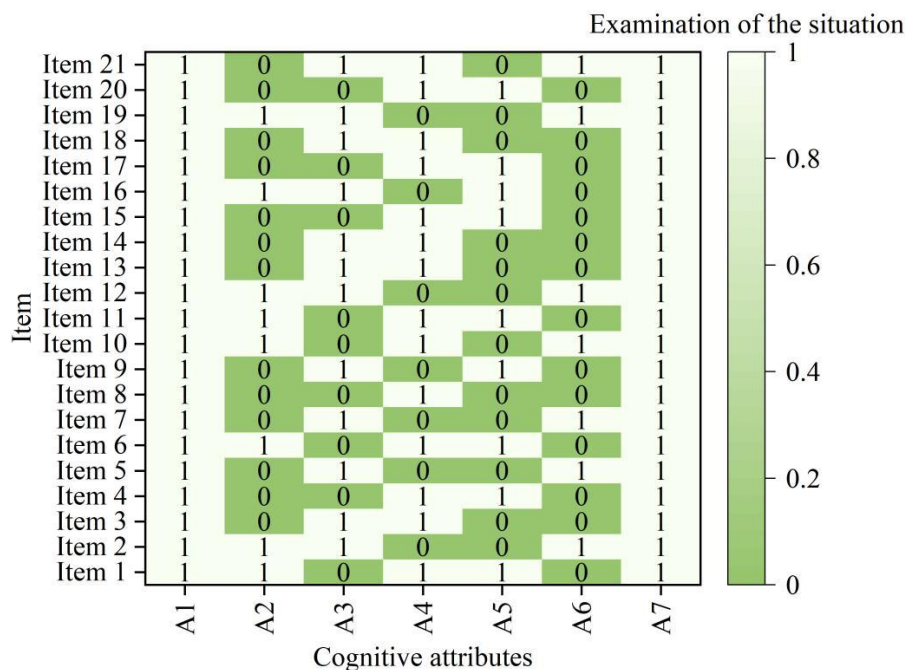


Figure 5: The initially established Q matrix

3.1.2 Cognitive Diagnostic Program Distinction Calculations

In order to be able to make the test paper have good differentiation ability for different cognitive attribute ability levels, the test paper items were first analyzed for differentiation. Table 1 shows the results of the calculation of the differentiation of the items of the prediction test paper. The range of the differentiation of the cognitive attributes of the 21 test items is $[0.6152, 0.8929]$, which is greater than the standard of passing of 0.45 and the standard of excellence of 0.60, which indicates that the prepared test paper can realize the differentiation of the students' cognitive attribute mastery levels and patterns well, and can be applied to the cognitive diagnostics of the students without any additional adjustments. The test paper can be applied to students' cognitive diagnosis without additional adjustments.

Table 1: Calculation results of item discrimination for the pretest questionnaire

Item	Question number	Distinguishability	Item	Question number	Distinguishability
Item 1	1	0.7495	Item 12	9-1	0.7828
Item 2	2-1	0.8929	Item 13	9-2	0.7521
Item 3	2-2	0.8084	Item 14	10	0.8367
Item 4	2-3	0.8653	Item 15	11	0.7328
Item 5	3	0.7194	Item 16	12	0.7905
Item 6	4	0.6152	Item 17	13	0.6979
Item 7	5	0.7401	Item 18	14	0.7551
Item 8	6-1	0.7154	Item 19	15	0.7662
Item 9	6-2	0.7918	Item 20	16	0.7933
Item 10	7	0.8655	Item 21	17	0.8159
Item 11	8	0.8186			

3.2 Analysis of students' ability to master curriculum Civics based on cognitive diagnosis

3.2.1 Probability of mastery of each attribute across classes

The prepared cognitive diagnostic test papers were distributed to 200 students (40 students in each class) in five first-year classes of Business English majors in College T to investigate the overall mastery of cognitive attributes of Civics in college English courses and the individual students' mastery of cognitive attributes in each class.

Figure 6 shows the probability of cognitive attribute mastery in the five classes. As the difficulty of cognitive attributes increases from A1 to A7, the probability of mastery in all five classes shows a decreasing trend. According to the order of the average mastery probability of cognitive attributes, the classes with the best mastery of Civics in college English courses are, in order, Class 2 (0.6700) > Class 1 (0.5660) > Class 4 (0.5640) > Class 5 (0.5475) > Class 3 (0.4868).

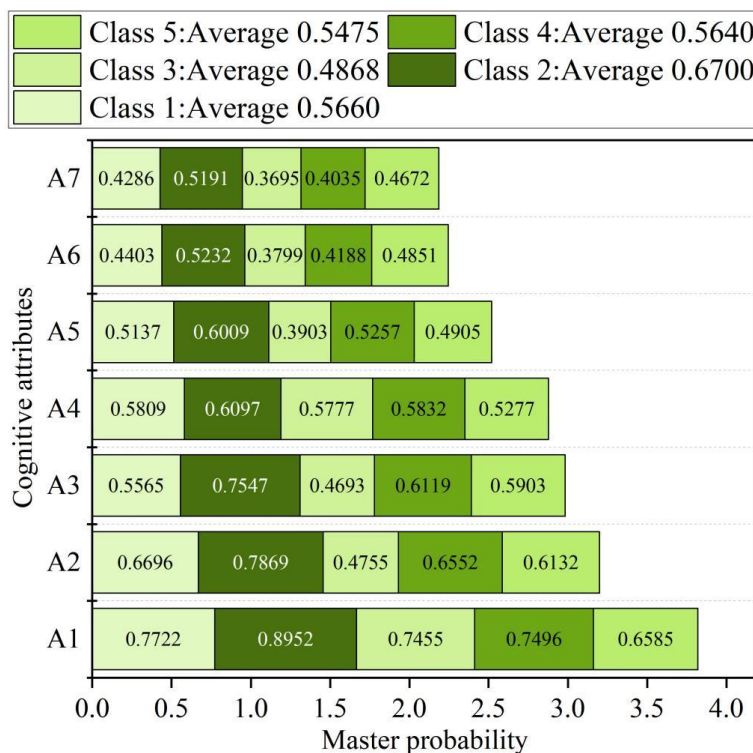


Figure 6: Probability of mastering the cognitive attributes of 5 classes

3.2.2 Student mastery of pattern recognition

After calculating the attribute mastery probability of all students the next step is to analyze the cognitive attribute mastery patterns of all students. Taking Class 4 with medium probability of mastering cognitive attributes as an example, Table 2 shows the results of cognitive attribute mastery patterns of 40 students in Class 4. The cognitive attribute mastery patterns of the 40 students are diversified and basically belong to the 19 ideal mastery patterns, which indicates that the students' mastery of the content of the Civics of the university English course is mostly in line with the norms of the students majoring in Business English and there is no excessive deviation from the norms.

Table 2: Cognitive attribute mastery model of Class 4 students

Student ID	Test project results	Attribute Mastery Model	Student ID	Test project results	Attribute Mastery Model
401	1010111111110011010	1010111	421	111110111111111101	1111110
402	111111011111111101	1111110	422	1111101100001010111	1111101
403	1011111011111011111	1011111	423	1110111011111111100	1110111
404	1110111011111111100	1110111	424	1011111000111101011	1011111
405	1011110111111111000	1011110	425	111111011111111101	1111110
406	1000000100110011111	1000000	426	1011110111110111111	1011111
407	1110000110111111011	1110000	427	1110111011111111100	1110111
408	1011110111110111111	1011110	428	1111101100001010111	1111101
409	1110011111110001111	1110011	429	1111100101110010100	1111100
410	1111110111111010101	1111110	430	1110111011111111100	1110111
411	1111111111111111111	1111111	431	1111000010100010000	1111000
412	1011111011111011111	1011111	432	0000000000000000000	0000000
413	1111111111111111111	1111111	433	1011110111110111111	1011111
414	1111100101110010100	1111100	434	1111100101110010100	1111100
415	1011110111110111111	1011111	435	1110111011111111100	1110111
416	1111100101110010100	1111100	436	1011110111110111111	1011111
417	0000000000000000000	0000000	437	1110111011111111100	1110111
418	1111101100001010111	1111101	438	1111111111111111111	1111111
419	1111000010100010000	1111000	439	0000000000000000000	0000000
420	1111111111111111111	1111111	440	1111000010100010000	1111000

3.2.3 Classification of Attribute Mastery Models

The cognitive attribute mastery patterns of a total of 200 students in five classes of college English courses in Civics were compared with the 19 ideal mastery patterns so as to categorize the cognitive attribute mastery patterns of the students. Figure 7 shows the results of categorizing the cognitive attribute mastery patterns. 100% of the 200 students' cognitive attribute mastery patterns can be categorized into the 19 ideal mastery patterns. Among them, 31 or 15.5% of the 1111110 patterns were categorized, 25 or 12.5% of the 1111111 patterns were categorized, and 2 or 1.0% of the 1011111 patterns and 1100000 patterns were categorized. The overall categorization shows that students with insufficient levels of mastery of one or more cognitive attributes are in the majority, and there is still much room for learning improvement.

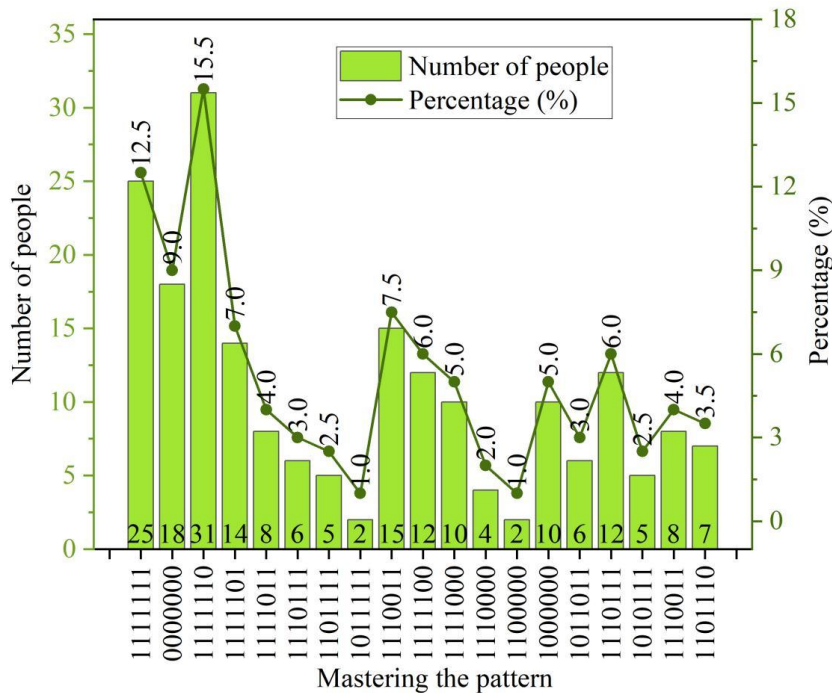


Figure 7: Classification results of the cognitive attribute mastery model

3.3 Learning path planning based on Q-learning algorithm

3.3.1 Overall types of learning paths for students with different cognitive states

After categorizing the students' cognitive attribute mastery patterns and constructing a hierarchical learning model, the Q-learning algorithm is utilized to plan the students' overall learning paths and individual learning paths. Table 3 shows the complete learning path planning results with the corresponding student profiles. Based on the students' cognitive attribute mastery, nine different learning paths are planned overall. The most numerous is Path 1, which only needs to consolidate the learning of cognitive attribute A7 (enhance the emotion of patriotism) or only needs to briefly review the basic knowledge of cognitive attributes, and is suitable for the 56 students in the cognitive attribute mastery patterns of 1111110 and 1111111. Path 9 “A1→A2→A3→A4→A5→A6→A7” is the longest, where students need to progressively learn from cognitive base A1 to the final cognitive goal of A7, and is suitable for 28 students in the 0000000 and 1000000 modes. The rest of the paths are suitable for students with deficiencies in the mastery of 1 or more cognitive attributes.

Table 3: Complete learning path type and the number of students

Type	Path	Total number of cognitive states
1	A1→A7	56
2	A1→A6→A7	26
3	A1→A5→A7	8
4	A1→A4→A7	6
5	A1→A2→A3→A7	32
6	A1→A4→A5→A7	8
7	A1→A4→A5→A6→A7	25
8	A1→A3→A4→A5→A6→A7	11
9	A1→A2→A3→A4→A5→A6→A7	28

3.3.2 Individual Learning Path Determination for Students with Different Cognitive States

The 9 general planning paths are suitable for teachers to grasp the preparation of blended teaching resources and the adjustment of the teaching content structure from the general direction, while a clearer planning of individual learning paths is needed for the 19 different mastery modes of students. The Q-learning algorithm is further utilized to calculate the competency values that can be achieved when each path is selected, and individual learning paths are planned for different types of students.

Table 4 shows the individual learning path types and the average competency values. Except for the students whose cognitive attribute mastery mode is 1111111, all the learning paths are able to improve the cognitive attribute learning ability value of the students in the most efficient way. 18 types of students are able to improve the cognitive attribute learning ability value of the individualized learning paths by 0.501 (path A1→A7) to 0.893 (path A1→A2→A3→A4→A5→A6→A7) after the individualized learning paths are planned. A7).

Table 4: Individual learning path types and average ability values

Type	Path	Classify the number of people in this path	Average ability value
1	Completed understanding	25	1.000
2	A1→A2→A3→A4→A5→A6→A7	18	0.893
3	A1→A7	31	0.501
4	A1→A6	14	0.623
5	A1→A5	8	0.711
6	A1→A4	6	0.685
7	A1→A3	5	0.582
8	A1→A2	2	0.549
9	A4→A5→A7	15	0.792
10	A6→A7	12	0.516
11	A5→A6→A7	10	0.750
12	A4→A5→A6→A7	4	0.813
13	A3→A4→A5→A6→A7	2	0.857
14	A2→A3→A4→A5→A6→A7	10	0.872
15	A2→A5	6	0.506
16	A4→A6	12	0.511
17	A2→A4	5	0.528
18	A4→A5	8	0.584
19	A3→A7	7	0.557

4 Conclusion

In this paper, the Q learning algorithm is used to plan learning paths according to students' cognitive attribute mastery patterns to help students improve their cognitive level of Civics and Politics in college English courses. The probability of mastery of seven cognitive attributes in the five subject classes is 0.4868~0.6700. The cognitive attribute mastery patterns of the 200 students can be categorized into the 19 categories of ideal mastery patterns, which can help to increase the solution efficiency of the Q learning algorithm. Efficiency. Overall, 9 learning paths are planned for students, and the learning paths for different individuals help to improve

the competence value of students to 0.501~0.893.

Combining the solved learning paths, teachers can better adjust the learning tasks before, during and after class for different students, and provide more appropriate learning resources such as micro-videos. Through more differentiated teaching, students' cognition of college English course Civics will be improved in all aspects.

Funding

This work was supported by Annual 2024 Hunan Province Normal Undergraduate Universities Teaching Reform and Research Project Approval Items (NO: 202401001403).

About the Author

Jing Tan was born in Anren County, Hunan Province, China, in 1980. She obtained a master's degree from Xiangtan University in China. I am currently working at the Foreign Language College, Xiangnan University. My main research direction is foreign language teaching and research.

References

- [1] Zhu, G., & Tao, T. (2021). Strategies for ideological and political education in colleges and universities from the perspective of general education. *Academic Journal of Humanities & Social Sciences*, 4(11), 18-23.
- [2] Li, L. (2017). Teaching of ideological and political education for college students from the perspective of culture. *DEStech Transactions on Social Science Education and Human Science*, 1, 656-661.
- [3] Feng, J., & Bai, Y. (2021). On the integration of ideological and political education into college English teaching. *Curriculum and Teaching Methodology*, 4(3), 1-5.
- [4] Yanli, L., Min, X., & Yuhua, C. (2020). The Application of the Teaching Mode for "Ideological and Political Education" in College English Teaching. *International Journal of New Developments in Education*, 2(7), 48-51.
- [5] Wang, J., & Zhu, M. (2022). Research on the construction of college English reading courses based on ideology and politics curriculum. *Scientific and Social Research*, 4(1), 182-186.
- [6] Tan, Y. (2023). Study on the Practical Path of "Curriculum Ideological and Politics" in College English. *The Educational Review, USA*, 7(1), 22-25.
- [7] Wu, H. (2023). Research on the paths and strategies of the integration and development of college English instruction and ideological and political education. *Adult and Higher Education*, 5(15), 88-93.
- [8] Huo, C. (2024). Research on Innovation in College English Teaching Based on Ideological and Political Education Integration. *International Journal of Educational Teaching and Research*, 1(2).

- [9] Li, X. (2020, May). Research on Integrating Ideological and Political Education into College English Teaching. In 6th International Conference on Humanities and Social Science Research (ICHSSR 2020) (pp. 102-106). Atlantis Press.
- [10] Hou, J., & Xue, J. (2023). Impact of the blended teaching model on learning outcomes. *International Journal of Emerging Technologies in Learning (Online)*, 18(5), 192.
- [11] Sutisna, E., & Vonti, L. H. (2020). Innovation development strategy for hybrid learning based English teaching and learning. *English Review: Journal of English Education*, 9(1), 103-114.
- [12] Nashir, M., & Laili, R. N. (2021). Hybrid learning as an effective learning solution on intensive English program in the new normal era. *IDEAS: Journal on English Language Teaching and Learning, Linguistics and Literature*, 9(2), 220232-220232.
- [13] Wang, L., & Du, Z. (2025). Intelligent Technology-Driven Hybrid English Classroom Model for Enhanced Personalization and Learning Efficiency. *Journal of Circuits, Systems and Computers*.
- [14] Vereshchahina, T., Liashchenko, O., & Babiy, S. (2018). ENGLISH LANGUAGE TEACHERS' PERCEPTIONS OF HYBRID LEARNING AT UNIVERSITY LEVEL. *Advanced Education*, 88-97.
- [15] Albiladi, W. S., & Alshareef, K. K. (2019). Blended learning in English teaching and learning: A review of the current literature. *Journal of language Teaching and Research*, 10(2), 232-238.
- [16] Wu, X. (2022). Research on the reform of ideological and political teaching evaluation method of college English course based on "online and offline" teaching. *Journal of Higher Education Research*, 3(1), 87-90.
- [17] Juan, H. (2023). Exploring the Innovative Path of College English Mixed Teaching Mode under the Concept of Curriculum Ideology and Politics. *Frontiers in Educational Research*, 6(16).
- [18] Chun, Y., & Fu, X. (2024). An Exploration of the Construction of Ideological and Political Education Model in College English Courses: A Study on the "BOPPPS+ Blended" Teaching Model. *Pacific International Journal*, 7(6), 25-30.