International Journal for Housing Science and Its Applications
Publish August 10, 2025. Volume 46, Issue 4 Pages 5627-5634

https://doi.org/10.70517/ijhsa464403

Research on Intelligent Guidance Pathways for English Grammar Teaching under a High-Level Cognitive Computing Framework

Yuanli Liu[1,*]
[1] School of Foreign Studies and Trade, Hubei University of Automotive Technology, Shiyan, Hubei, 442002, China
Corresponding authors: (e-mail: 20060033@huat.edu.cn).

Abstract The current English grammar teaching is generally characterized by the problems of single teaching method, insufficient personalized instruction, and lack of scientific assessment of teaching effect. The traditional teaching mode is difficult to adapt to the cognitive characteristics and learning needs of different learners, and teachers lack intelligent support in the selection of grammar knowledge points and teaching path design. Based on the higher-order cognitive computing framework, this study constructs an ant colony algorithm-driven intelligent instructional path design model for English grammar teaching. Adopting the improved clustering method of ant foraging principle, 100 English teachers were selected as the research samples, and an evaluation system containing a total of 12 characteristic parameters in four dimensions of teaching content, teaching ability, teaching attitude, and academic level was established. The two-part graph maximum matching algorithm and MMAS pheromone updating mechanism are used to design the intelligent instruction path generation strategy by combining the three elements of form, meaning and usage of Larsen-Freeman three-dimensional grammar teaching theory. The experimental results show that the improved algorithm achieves an accuracy of 86.13% in the recognition of A-rank teachers and 89.69% in B-rank, which is 6.09% and 10.43% higher than the original algorithm, respectively. The effectiveness of the algorithm was verified through 8 iterations of clustering analysis on 10 teachers. The intelligent guidance system constructed by the study can automatically determine the structural, functional or combined structural-functional teaching features according to the teaching grammar attributes, provide a personalized path optimization plan for English grammar teaching, and improve the teaching quality and learning effect.

Index Terms Ant Colony Algorithm, English Grammar Teaching, Intelligent Guidance Path, Higher Order Cognitive Computing, Cluster Analysis, Teaching Evaluation

I. Introduction

Grammar knowledge is an important part of language knowledge in the English curriculum, and grammar teaching is the focus and difficulty in English teaching [1]. However, there is a phenomenon of “separation of learning and use” in students' grammar learning [2]. Some grammar teaching is mainly in the form of teacher's explanation and student's note-taking, and students' practice in the classroom is mainly in the form of fill-in-the-blanks and multiple-choice questions, which seems to be more mechanical and single [3], [4]. This leads to the fact that students can't really use grammar knowledge, that is, when encountering a new grammar situation, students can't link what they have learned in the classroom with the actual problems they need to solve, and realize the transfer of knowledge to use [5].

To learn English grammar, the first thing to do is to clarify the content of learning [6]. The three-dimensional grammar framework proposed by some studies divides grammar learning into three dimensions: form, meaning and use [7]. Among them, form refers to visual and auditory linguistic units, such as written symbols, sounds, sentence structures, etc. Meaning refers to the significance of a linguistic form when it is taken out of a specific context. Use refers to the occasion and why the language is used [8], [9]. After grammar teaching, students should learn to choose appropriate grammatical forms to understand and express meanings in different contexts so as to achieve the purpose of intercultural communication [10].

At present, the English grammar teaching system in Mainland China is still at the stage of being influenced by structuralist linguistics and transformational generative linguistics [11]. Structuralist grammar teaching focuses on linguistic forms and mechanical drills, while transformational generative grammar teaching focuses on the rules and steps of transformation between deep and surface structures [12]. However, the former often lacks context and information expression awareness, and the latter does not pay attention to the semantic and pragmatic differences between expressions before and after conversion, and both approaches are difficult to stimulate students' interest and enthusiasm, which is less helpful to the current predicament of grammar teaching [13]. English grammar teaching urgently needs to seek new ideas and new perspectives.

Based on the framework of higher-order cognitive computation, this study introduces the group intelligence characteristic of ant colony algorithm and constructs a model of intelligent instruction path design for English grammar teaching. First, the neural mechanisms of higher-order cognitive functions are analyzed, especially the processing of emotional response and aesthetic cognition, to provide theoretical support for understanding the cognitive basis of grammar learning. Second, the clustering algorithm applicable to teaching evaluation is designed by combining the mathematical model of ant colony algorithm and the pheromone updating mechanism of MMAS. Once again, the Larsen-Freeman three-dimensional grammar teaching theory is applied to establish a teaching feature recognition system containing three elements: form, meaning and usage. Finally, the effectiveness and practicality of the algorithm is verified through empirical research to provide a scientific and intelligent guidance program for English grammar teaching.

II. Higher-order cognitive computing framework

II. A. Higher-order cognitive functions

Higher cognitive functions are complex cognitive functions that require multiple brain regions to work together and different brain regions to perform different functions. For example, when people learn, they need to view books, understand the shapes and meanings of the Chinese characters in the books, search for the context in their memory, and maintain their attention and concentration to complete a series of processes. This series of cognitive processes requires the orderly participation of different cerebral cortexes. In the study of higher cognitive functions, scientists have explored the cognitive processes of higher-order cognitive functions in terms of the cognitive activities of different brain regions.

As the prefrontal, temporal, and parietal lobes of the brain are involved to different degrees in higher cognitive activities, the cognitive process of higher cognitive functions has been explored from the cognitive activities of different brain regions. And in different higher-order cognitive functions, the degree of their participation and the regions involved are not the same. Therefore, this paper mainly focuses on two aspects of higher-order cognition, namely, emotional response and aesthetics, and introduces the existing research results of scientists on the basis of these cognitive activities and their relationship with other higher-order cognitive functions.

II. B. Neural Mechanisms of Emotional Reactions

II. B. 1) Perceptual processing of emotions

Emotional response is the process of selectively detecting and reacting to information in the environment that is relevant to an emotional goal (e.g., triggering panic, happiness, sadness, etc.). It is an important factor in the ability of humans to adapt to their surroundings, to respond emotionally, and to communicate socially in the midst of evolution.

Perceptual processing of emotions refers to the rapid perception of emotional stimuli and selective attention at an early stage. Perceptual processing of emotions involves two processes: first, the brain perceives stimuli with emotional information quickly and selectively, as opposed to neutral stimuli. This process triggers enhanced activity in several perception-related brain regions. These include specific regions, such as those associated with selective attention, and generalized regions, such as the visual and auditory cortex and the prefrontal-parietal attentional network. Second, in contrast to other mechanisms of attentional tuning to stimuli (e.g., prefrontal-parietal activity), perceptual processing of emotions requires detailed and complete perception and discrimination of the emotion in the stimulus by emotion-related regions of the brain, a process that ERP studies have shown occurs predominantly between about 120 ms and 170 ms after stimulus presentation. . During this process, the perception of emotions is processed by different brain regions than the perception of ordinary stimuli. These differences include early observable differences in the activity of limbic system regions of the brain, such as the amygdala and the prefrontal cortex.

II. B. 2) Cognitive processing of emotional meaning

After the perception and discrimination of the emotional information contained in the stimulus, it is also necessary to recognize the concepts contained in the emotional information that has been selectively perceived as well as discriminated. This step of conceptual knowledge processing of emotional information occurs mainly after 300 ms of stimulus presentation. In the cognitive processing of emotions, the cortex associated with mirror movements, such as the right ventral primary and secondary sensorimotor cortex, plays an important role. In addition, cognitive processing of emotions requires the involvement of areas such as the striate cortex, superior colliculus, and thalamus. These cortices work together to achieve cognition as well as understanding of emotions. Current research on cognitive processing of emotions has not yet fully elucidated how humans make sense of emotions. One hypothesis is that cognitive processing of emotional information involves mirroring the emotion contained in the stimulus and visualizing the emotion to obtain the information contained in the emotion. That is, cognition of others' emotions relies on modeling and reproducing the perceived emotions.

II. C.Neural Mechanisms of Aesthetics

Among the higher-order cognitive functions of human beings, the aesthetic cognitive function is an important part of it. The aesthetic cognitive function enables people to feel and judge the beauty of things, and it is also closely related to the origin of human culture and art and its development. Without the function of aesthetic cognition, people would not be able to feel the beauty of dances, paintings and art works, and they would not be able to have an aesthetic preference for things in their lives; art would no longer exist. The study of the neural mechanism of aesthetic cognition function is also to provide reliable theoretical support and modeling basis for the development of robot art creation with artificial intelligence. The neural mechanism of aesthetic cognitive function has been studied by a large number of scientists. A large number of studies on the function of aesthetic cognition, so that people have a certain knowledge of the brain mechanism of aesthetic cognition. It is generally believed that the process of aesthetic cognition involves attention to things, perception, combination with one's own experience, and cognitive processing of the perceived things; to achieve the aesthetic judgment of things and aesthetic emotions. However, different scientists have put forward different opinions on the specific steps needed to carry out aesthetic cognition. Although current research has confirmed the close relationship between some brain regions and human aesthetic cognition, and proposed cognitive models of aesthetic cognition. However, these models still cannot fully explain the neural mechanism of human aesthetic cognition and evaluation of things. And there are still a lot of controversies about their correctness and reliability. Therefore, if we want to fully understand the neural mechanisms of aesthetic cognition and cognitive processes, we still need to make unremitting exploration.

III. Intelligent Instructional Path Design for English Grammar Teaching Based on Ant Colony Algorithm

III. A. Ant Colony Algorithm

III. A. 1) Mathematical modeling

Mathematical modeling of ant colony algorithms:

$$P_{ij}^{k}(t)=\begin{cases}\dfrac{\left[\tau_{ij}(t)\right]^{\alpha}\left[\eta_{ij}\right]^{\beta}}{\sum\limits_{s\in allowed_i}\left[\tau_{is}(t)\right]^{\alpha}\left[\eta_{is}\right]^{\beta}} & j\in allowed_k\\ 0\end{cases}\tag{1}$$

$tabu_k(k=1,2,3,\cdots n)$ denotes the set of all nodes that ant k has currently traveled through, and $allowed_k$ denotes the set of points that ant has not traveled through:

$$\tau_{ij}(t+n)=(1-\rho)\cdot\tau_{ij}(t)+\Delta\tau_{ij}\tag{2}$$

$$\Delta\tau_{ij}=\sum_{k=1}^{m}\Delta\tau_{ij}^{k}\tag{3}$$

ρ denotes the pheromone volatilization coefficient, then $(1-\rho)$ denotes the pheromone residual factor, and $\Delta\tau_{ij}$ denotes the pheromone increment on the (i,j) path in the current cycle, and denotes the amount of information that is residual on the (i,j) path of the k th ant in the current cycle:

$$\Delta\tau_{ij}^{k}=\begin{cases}\dfrac{Q}{L_k}\ \text{If the kth ant passes through } (i,j) \text{ in this cycle}\\ 0\end{cases}\tag{4}$$

$$\eta_{ij}=\frac{1}{(100-d_{ij})}\tag{5}$$

where d_{ij} is the student's satisfaction level with a particular course taught by a particular instructor. The parameters of the algorithm, such as the information heuristic factor α, the expectation heuristic factor β, the number of ants m, the volatility coefficient ρ, etc., are derived from eil51 in the simulation experiment of TSPLIB, and the research on the intelligent instructional path problem of English grammar teaching based on the ant colony algorithm. In the algorithm, $m=5$, maximum number of iterations $=40$, $\alpha=1$, $\beta=5$, $\rho=0.3$, $\tau_{\max}=1000$, $\tau_{\min}=0.01$, and $Q=20$ are selected.

III. A. 2) MMAS pheromones

After each cycle, only one ant makes the pheromone update. The value domain of pheromone of each ant is limited to $[\tau_{\min},\tau_{\max}]$, when the value of pheromone $\tau>\tau_{\max}$, take $\tau=\tau_{\max}$, and vice versa when the value of pheromone $\tau<\tau_{\min}$, take $\tau=\tau_{\min}$ [14].

III. A. 3) Maximum matching of bipartite graphs

A graph is a mathematical model that uses points and lines to portray a discrete set of things that are connected in some way. A graph can be used to represent the good and bad teaching quality of the teacher being evaluated. It is represented by the triad $G(N,A,B)$ of the graph, where $N=1,2,3,\cdots,n$ is the set of vertices of the graph G, A is the set of all edges in the graph, and B is the set of eigenvalues of the edges. The bipartite graph is applied in the algorithm to look at <English grammar points, class, teacher>, <teacher, student satisfaction, English grammar point names> as two interconnected models to find the maximum match. A bipartite graph is a special model in graph theory. Let $G=(A,B)$ be an undirected graph if the vertices V can be partitioned into two disjoint subsets (A,B) and the two vertices associated with each edge in the graph belong to these two different vertex sets. The triple G in N sees the relational schema <English grammar point, class, teacher> as the set of leftmost points and <teacher, student satisfaction, English grammar point name> as the set of rightmost points. The points on the left in A are matched with the points on the right, and only matches that satisfy certain conditions are concatenated. The weight in B is the satisfaction level of students on the matching side with this English grammar knowledge point.

The relational model <English grammar knowledge point, class, teacher> is abbreviated as P, and <teacher, student's satisfaction, English grammar knowledge point name> is abbreviated as G. The data in the <English Grammar Knowledge Points, Class, Teacher> relation comes from the Registrar's Office before the lesson is taught. Consider P as the leftmost set of points, and the relationship model G is the rightmost set of points, use the Cartesian product to connect the vertices on the left and right sides, and the weights in the connection are the average of the students' overall evaluations of the lecturer, and the largest weight that meets the conditions is selected as the maximal match among all the weights.

Using the ant colony algorithm in solving the classic TSP problem, each ant starts from the initial city node, must pass through each city in the graph, and can only pass through once, when all the cities are experienced, the ants complete a traversal. In the teacher evaluation process for ant traversal is indeed different, in the created two-part graph model, all ants start from a node in the left A set of the two-part graph, find a matching node in the right B set, and then the ants return to the left set A, where the next starting point and the previous end point are logically considered to be one node. So on and so forth, until the ant completes all the matches in the set A, B, the ant's traversal is not complete.

III. B. Intelligent Guided Path Steps

The study of grammar teaching must focus on and clarify the "teaching grammar". Since the 80s of the 20th century, the American scholar Larsen-Freeman has carried out a systematic exploration in the field of English teaching grammar and formed a three-dimensional grammar teaching theory. The use of grammar is a dynamic process, and grammar teaching should not only enable students to pay attention to and understand the grammatical structure, but also train them to understand and use grammatical meaning appropriately, so as to realize the automation of grammar use, that is, grammar teaching should include three aspects: form, meaning and usage. In his three-dimensional framework of teaching grammar analysis, "form" includes phonetics, symbols, morphology, and syntax, "meaning" refers to meaning when presented in isolation in a particular form, and "usage" refers to the speaker's intention in a particular communicative context. The theory of three-dimensional grammar teaching breaks through the morphological and syntactic level of the traditional grammatical view at the language level, especially the "use" dimension brings the understanding of grammar and its use into the context of discourse or discourse, the unit of language communication, so grammar teaching should help learners construct three-dimensional grammatical consciousness from the beginning. In this study, the Larsen-Freeman three-dimensional grammar teaching theory was applied, combined with the basic understanding of teaching grammar and grammar teaching, and the teaching grammar attributes "form, meaning, and usage" were taken as the main variables to identify and judge the teaching characteristics of "structure", "function" and "structure-function".

Step 1: According to the actual teaching practice, extract the teaching grammar attributes involved. According to the content of the lecture, determine what are the teaching grammar attributes involved, and list the attributes involved one by one. The attributes involved may be as one of the "form", "meaning", or "usage", or there may be two or three of them.

Step 2: Extract the prominent teaching grammar attributes according to the teaching time. It is generally accepted that the duration of teaching is a variable that reflects the importance of the grammatical attributes of teaching. Therefore, we can extract the prominent teaching grammatical attributes by calculating the teaching time of each attribute. This is divided into two situations: (1) When a single instructional grammatical attribute is involved, that attribute is the prominent instructional grammatical attribute. For example, if only one teaching grammatical attribute of "form" appears in the introduction process, the prominent teaching grammar attribute is determined to be "form". (2) When more than one attribute is involved, the longer one is the prominent teaching grammar attribute; When the time spent is equal, it is considered a salient attribute. For example, if there are only two teaching grammatical attributes, "form" and "meaning", which need to be further judged, there are only two teaching grammatical attributes in the introduction process. If the teaching activity related to "meaning" takes 30 seconds and the "form" time is 10 seconds, the prominent teaching grammar attribute is judged to be "meaning". If the time taken for "meaning" and "form" is 20 seconds, the prominent teaching grammar attribute is judged to be "meaning + form".

Step 3: According to the outstanding teaching grammar attributes, determine the tendency of "structure" and "function" teaching grammar features. The intelligence of ant colony algorithm is used to guide the English grammar teaching path. Teaching grammar features tend to be divided into the following three situations:

(1) When the prominent teaching grammar attribute is "form", it corresponds to the "structure" teaching feature. (2) When the prominent teaching grammar attribute is "meaning" or "usage", it corresponds to the "functional" teaching feature. (3) When the prominent teaching grammar attributes are "form + meaning", "form + usage" and "form + meaning + usage", it corresponds to the teaching characteristics of "structure-function".

IV. Ant Colony Algorithm Applied to English Grammar Teaching Intelligent Guidance

Attempts were made to use the improved clustering method of ant foraging principle to cluster the input parameters, and to categorize the results of the evaluation of English grammar teaching into the following five classes: A, B, C, D, E. The corresponding grades corresponded to the scores of the teaching evaluation: [90-100], [80-90], [70-79], [60-69], and [0-59].

IV. A. Parameter selection

Combining the evaluation of English grammar teachers by supervisors in higher vocational colleges and universities, the evaluation of teachers by students, the evaluation of peer teachers and the basic information of teachers, integrating the relevant factors from four aspects, including English grammar teaching content, teaching ability, teaching attitude and academic level, and applying the hierarchical analysis method (AHP) for validation, 12 characteristic parameters were determined as the final sample parameters, and based on the expert group's knowledge, experience and value judgment, the weight of each parameter was determined, and the results are shown in Table 1.

Table 1: feature parameters and weights

Primary parameter	Secondary characteristic parameter	Weighting
Teaching content	Follow the outline and execute the teaching plan	0.04
	Be fully prepared, grasp the key points and difficulties	0.10
Teaching ability	The language specification, the work of the board, the layout is reasonable	0.12
	Heuristic teaching, arouse students to seek knowledge	0.13
	Reasonable and effective use of teaching methods	0.09
Teaching attitude	Teaching work enthusiasm, full of spirit, serious, input	0.14
	Follow the teaching discipline, on time and over	0.07
	The lecture is serious and rigorous	0.08
	The right amount of operation is timely	0.04
Academic level	Teacher degree	0.06
	Knowledge is broad, teaching can absorb multi-disciplinary knowledge	0.09
	Have certain teaching ability	0.04

IV. B. Data pre-processing

(1) Collecting Primary Data. Data related to 100 English teachers in the first semester of the 2023-2024 academic year in a vocational university were randomly selected.

(2) Data cleaning. In this study, some teachers did not attend classes due to sitting or other circumstances, then these teachers could not be used as sample data. In addition, due to various data quality problems, there are incorrect values in the database. For example, if a teacher's number should be 5 digits, but a teacher's number is 7 digits in the database, the record can be deleted. If the sample is insufficient for primary selection due to the above situation, secondary data selection is required. The sample data used in this study are decimal, and the amount of data is not very large, so there is no need to transform and normalize the data.

IV. C. Experimental results and analysis

(1) Consider each teacher as a sample as a cluster: $C_1^0=\{T_1\}$, $C_2^0=\{T_2\}$, $C_3^0=\{T_3\}$, $C_4^0=\{T_4\}$, $C_5^0=\{T_5\}$, $C_6^0=\{T_6\}$, $C_7^0=\{T_7\}$, $C_8^0=\{T_8\}$, $C_9^0=\{T_9\}$, $C_{10}^0=\{T_{10}\}$. Calculate the distance matrix $M^{(0)}$, which is calculated as $M_{ij}=\sqrt{\sum(X_i-X_j)^2}$, and the results of the calculation are shown in Table 2.C01~C10 are the knowledge points of the English grammar: nouns, pronouns, numerals, articles, adjectives, adverbs, syntax, simple sentences, tense, and mood.

Table 2: Each teacher is the distance matrix of the cluster

	C01	C02	C03	C04	C05	C06	C07	C08	C09	C10
C01	0									
C02	0.3	0								
C03	0.49	0.35	0							
C04	0.51	0.4	0.33	0						
C05	0.62	0.48	0.24	0.44	0					
C06	1.1	0.91	0.66	0.78	0.52	0				
C07	0.59	0.75	0.95	0.82	1.08	1.51	0			
C08	0.47	0.45	0.95	0.35	0.69	1.03	0.56	0		
C09	0.47	0.33	0.26	0.27	0.42	0.75	0.84	0.38	0	
C10	1.56	1.81	1.56	1.66	1.38	0.94	2.41	2.1	1.7	0

(2) The smallest array element in $M^{(0)}$ is 0.24, which is the distance between C_3^0 and C_5^0, and combining them into a single cluster yields the new clusters: $C_1^0=\{T_3,T_5\}$, $C_2^0=\{T_1\}$, $C_3^0=\{T_2\}$, $C_4^0=\{T_4\}$, $C_5^0=\{T_6\}$, $C_6^0=\{T_7\}$, $C_7^0=\{T_8\}$, $C_8^0=\{T_9\}$, $C_9^0=\{T_{10}\}$, and compute the distance matrix after the merger, $M^{(1)}$, and so on until all the clusters merge completely.

(3) According to the results of ACO clustering, these 10 teachers can be divided into 8 iterative processes:

The 1st time is for teachers with job number $\{0107030\}$, $\{0107032\}$.

The 2nd time is for teachers with job number $\{0107036\}$.

The 3rd time is for teachers with job number $\{0104031\}$, $\{0107028\}$, $\{0107029\}$.

The 4th time is for teachers with job number $\{0107029\}$, $\{0107030\}$, $\{0107031\}$.

The 5th time is for teachers with job number $\{0107035\}$.

The 6th time is for teachers with job number $\{0107033\}$.

The 7th time is for teachers with job number $\{0107034\}$.

The 8th time is the teacher whose work number is $\{0107037\}$.

In this paper, the assessment is using the student assessment scores, using hierarchical clustering results tree, the results are shown in Figure 1, from the figure can clearly see the clustering of the observations, the clustering results are very obvious.

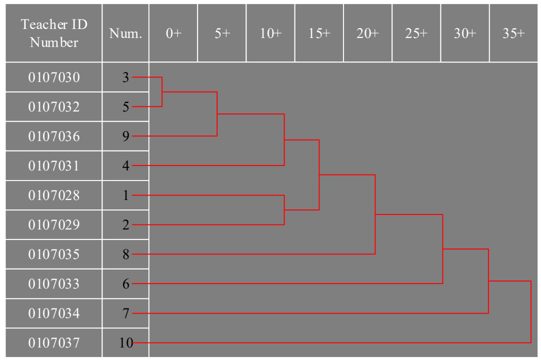

Figure 1: Hierarchical clustering result tree

The results of the research on the application of ant colony clustering algorithm to the evaluation system of English grammar teaching are analyzed:

(1) If the teacher's English grammar teaching is full of content, clearly organized, inspiring and guiding, and the lectures are in-depth and simple, it can be generally recognized by the students, and also achieve better evaluation results. The results show that if the teaching content meets the requirements of the syllabus of the teaching regulations, the point of view is correct, the concept is clear, the examples are appropriate, the key points are prominent, and the students can understand easily, the teaching content is easier to arrange, the teaching effect is intuitive, the key points are prominent, and the students are easy to accept, and the result of this analysis is in line with the actual situation.

(2) Like syntax, lexicon of this kind of course is the integration of science and practice, teaching intuitive, practical, teachers let students operate while teaching, teaching content is easy for students to accept, so this kind of course teaching evaluation is usually higher. Like the tense of this kind of course abstract, theoretical, teaching effect is not very intuitive, the teaching effect is not high, which is consistent with the fact that the situation.

From the results of the theoretical analysis of the ant colony clustering algorithm, it is concluded that the students' evaluation of the courses should be different for different courses, and the scoring indexes should be different, so as to objectively achieve a fair and impartial evaluation of a teacher's teaching effectiveness. Because it can be seen from the results of the students' ratings, the students' professional courses, public courses of study on the teacher's requirements are different, so each school in the development of the course rating standards should be treated differently, the development of different teaching assessment rating standards.

IV. D. Clustering correctness

The ant foraging principle clustering algorithm and the improved algorithm are used to cluster the sample data separately. The results of the correct rate of clustering are shown in Fig. 2. The results can be seen that, after improving the algorithm, the correct rate of clustering of grade A is increased from 80.04% to 86.13%, the correct rate of clustering of grade B is increased from 79.26% to 89.69%, the correct rate of clustering of grade C is increased from 75.43% to 78.48%, the correct rate of clustering of grade D is increased from 70.3% to 82.91%, and the correct rate of clustering of grade E is increased from 79.95% to 82.99%. The results show that the correct rate of the improved algorithm is higher than that of the original algorithm.

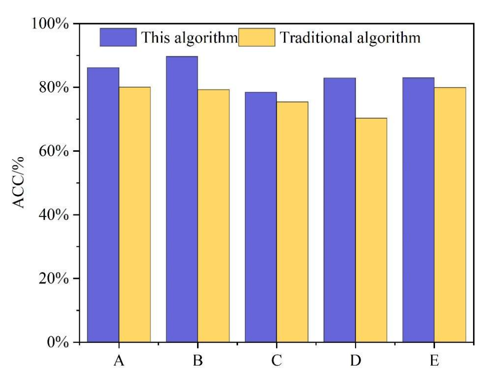

Figure 2: The two algorithms are compared in the sample number

V. Conclusion

The study shows that the ant colony algorithm demonstrates significant advantages in the design of intelligent guidance paths for English grammar teaching, and the effectiveness and practicality of the method is proved through the cluster analysis of 100 teacher samples. The improved algorithm performs well in the evaluation of teachers' teaching quality, in which the recognition accuracy of B-grade teachers is as high as 89.69%, and the recognition accuracy of D-grade teachers is increased to 82.91%, which fully reflects the effectiveness of the algorithm optimization. The evaluation system constructed based on 12 characteristic parameters can comprehensively reflect the teaching level of teachers, covering four core dimensions: teaching content, teaching ability, teaching attitude and academic level.

The experimental results show that 10 teachers were successfully categorized scientifically through 8 iterations, which verifies the stability and reliability of the clustering algorithm. The intelligent guidance system is able to automatically identify teaching features according to the Larsen-Freeman three-dimensional grammar teaching theory, effectively differentiate between structural, functional and combined structural-functional teaching modes, and provide teachers with personalized teaching path suggestions. This study provides new technical means and theoretical support for the reform of English grammar teaching, which helps to improve teaching quality and learning effect. In the future, we can further expand the sample size, optimize the parameters of the algorithm, explore more dimensional teaching evaluation indexes, promote the in-depth application of intelligent educational technology in the field of language teaching, and provide a more scientific and effective solution for cultivating students' grammar usage and communicative competence.

Funding

Teaching Reform Research Project of Hubei University of Automotive Technology in 2024 (JY2024052); Special Research Project on the Teaching Reform of Ideological and Political Education in Courses of Hubei University of Automotive Technology in 2022 (22mdsz20).

References

[1] van Rijt, J. H., & Coppen, P. A. J. (2021). The conceptual importance of grammar: Knowledge-related rationales for grammar teaching. Pedagogical Linguistics, 2(2), 175-199.
[2] Demir, Y. (2018). English course and its grammar: Discovering attitudinal relationships and differences in terms of some variables. Kastamonu Education Journal, 26(6), 1981-1990.
[3] Zhang, D. (2012). Vocabulary and grammar knowledge in second language reading comprehension: A structural equation modeling study. The modern language journal, 96(4), 558-575.
[4] Myhill, D., Jones, S., & Watson, A. (2013). Grammar matters: How teachers' grammatical knowledge impacts on the teaching of writing. Teaching and teacher education, 36, 77-91.
[5] Saengboon, S., Kosin, P., & Toomaneejinda, A. (2022). The roles of grammar in English language teaching: Local viewpoints. Pasaa, 63(1), 179-204.
[6] Myhill, D., & Watson, A. (2014). The role of grammar in the writing curriculum: A review of the literature. Child Language Teaching and Therapy, 30(1), 41-62.
[7] Powell, R. B. H. . (2004). Teaching language: from grammar to grammaring. Tesol Quarterly, 38(1), 172-173.
[8] Khansir, A. A., & Pakdel, F. (2016). Place of grammar in English language teaching. Language in India, 16(2), 140-149.
[9] Simonova, I. (2019). Blended approach to learning and practising English grammar with technical and foreign language university students: comparative study. Journal of Computing in Higher Education, 31(2), 249-272.
[10] Rao, P. S. (2019). The role of grammar in English language teaching (ELT) techniques. Research Journal of English (RJOE), 4(2), 239-249.
[11] Du, M., & Qian, Y. (2022). Application of massive open online course to grammar teaching for English majors based on deep learning. Frontiers in psychology, 12, 755043.
[12] Akay, E., & Toraman, Ç. (2015). Students' attitudes towards learning English grammar: A study of scale development. Journal of Language and Linguistic Studies, 11(2), 67-82.
[13] SVALBERG, A. M. L. (2015). Understanding the complex processes in developing student teachers' knowledge about grammar. The Modern Language Journal, 99(3), 529-545.
[14] Yan Xia. (2023). Innovative Teaching Via Sustainable Vocational Education with an Improved Ant Colony Algorithm. IEIE Transactions on Smart Processing & Computing,12(5).