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Exploration of English Online Interactive Mode Based on KMP Algorithm

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ABSTRACT

English learning requires much practice to improve students' comprehensive English application abilities. Online interactive mode for English learning can break time and space constraints. However, there are challenges in matching subjective English questions and English simultaneous typing on online platforms. Therefore, this paper introduces and improves the KMP algorithm in the context of English online interactive mode to enhance its matching performance. Experimental results show that the improved KMP algorithm effectively reduces the number of matches, improves matching efficiency, and demonstrates better application results. Applying the English online interactive mode based on the KMP algorithm effectively helps students improve learning and practice efficiency and promotes learning quality.

Keywords: KMP Algorithm, English, Online English, Interactive Mode

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1. Introduction

To meet the demand for compound talents in the context of social development, universities have accelerated the pace of educational reform with the support of information technology and created a smart teaching environment through the Internet. Compared with traditional teaching models, students are the teaching core in the Internet+ education model, and teachers play a guiding role by using Internet platforms to create integrated online and offline teaching classrooms, optimize teaching resources, tailor teaching to individual students, and enhance teaching effectiveness [1]. English is a language course with dual attributes, and its knowledge-oriented and humanistic nature determines its teaching goal of cultivating students' cultural literacy and comprehensive English application abilities. At the same time, language is an important means of information dissemination and interpersonal communication, and its learning requires a language environment and interactive communication. Through communication, students strengthen language application, develop their language processing abilities, and promote the development of their language skills [2]. Therefore, the online teaching mode can create a good English language environment for students and increase communication among students and others.

The knowledge-oriented nature of the English language indicates that there are certain criteria for its learning process. In contrast, humanistic nature suggests it has strong subjectivity in expression. This means that althoughthe English language has a certain regularity, there is no unique criterion for judging its subjective expression content [3]. Therefore, students need help to achieve self-judgment and correction while learning English through interactive online modes. This requires that the online interactive teaching system can guide students. However, many current online interactive teaching systems need better recognition effects on language-based simultaneous typing, which limits their ability to help students improve the efficiency of content conversion in English. In addition, they also have a high error rate in judging subjective English questions, making it difficult to provide reliable and effective guidance for students. Based on this, this paper introduces the KMP algorithm into the English online interactive teaching system. It optimizes its matching performance to improve English speech recognition and subjective question judgment, thereby achieving higher accuracy in judging subjective English questions, enhancing the quality of online English teaching, and providing more effective help for students and teachers.

2. Research Status of Online Teaching Interactive Modes

Internet and information technology development has provided new educational reform and development approaches. In the early stages, teachers accessed more teaching resources through the Internet, allowing students to obtain teaching videos outside of class, thereby achieving the purpose of supplementary learning and continuous learning, giving rise to the flipped classroom teaching model [4]. The application of the flipped classroom in universities has achieved remarkable teaching outcomes and is highly favored by college students, promoting its widespread development. The flipped classroom model is based on relevant teaching videos and materials. Students need to clarify their learning objectives, identify problems during preview and learning, and then the teacher provides explanations based on the questions raised by the learners [5]. Such a learning model requires a combination of online and offline teaching, but many self-learners may need to discover their problems during the self-learning process promptly. They may not obtain corresponding answers for help. Given this, some researchers proposed the micro-classroom teaching model, which differs from the flipped classroom in that it utilizes learners' fragmented time to complete the teaching of knowledge points. The content of micro-classroom teaching is concise and brief, combining teacher explanations, video animations, and real case studies to help students understand and master the teaching content [6]. This mode focuses on supplementing and assisting learners with knowledge points; although it can improve the utilization of learners' fragmented time, it may also lead to fragmented knowledge points. With the widespread adoption of Internet technology, some scholars have built interactive English online teaching modes based on open networks, which can more flexibly and freely assist learners in completing English learning tasks. Some scholars have implemented online teaching interactive modes through live broadcasting systems, but such pure online teaching modes have deficiencies in student and learning management [7]. Therefore, some scholars have introduced intelligent algorithms and big data technology to analyze learners' behavioral data and statistics and analysis of learners' practice data, which can greatly help teachers improve the efficiency of student management and promote the quality of English teaching [8].

3. English Online Interactive Mode Based on KMP Algorithm

3.1. KMP Algorithm and its Improved Algorithm

The KMP algorithm is one of the efficient algorithms for solving string-matching problems based on previously matched effective information in the pattern string. It calculates the internal matching information of the pattern string in advance when performing string matching [9]. It finds the longest substring in the completed matched pattern string when encountering a matching failure. It moves it to the position where the prefix and suffix can overlap with the main string for continued matching, thereby reducing the number of string matches. If the pattern string and the main string match completely, the specific position of the pattern string in the main string will be returned. The core idea of the KMP algorithm mainly consists of three steps:

Firstly, given the pattern string to find the longest prefix and suffix contained in it, and the lengths of the two are equal.

Secondly, based on the longest common element in each substring's prefix and suffix, move the pattern string as a whole one position to the right. Set the initial value as -1 so the moved array will

be solved.

Finally, if the suffix in the pattern string and the substring in the main string match completely, but the match between and fails, then the pattern string needs to be moved to the right to align the prefix in the pattern string with the corresponding substring in the main string. Continue the matching between the suffixes.

The KMP algorithm has a time complexity, mainly reflected in the number of matches during the matching process between the pattern string and the main string, as well as the computation of, the length of the pattern string. Therefore, reducing the number of matches can improve the matching speed when matching data strings on a large scale. English's online interactive teaching mode generates a large amount of data, and the platform software must complete data matching quickly. To improve efficiency, this paper has made improvements to the KMP algorithm.

As shown in formula (1), it represents a set expression:

$$\lambda_m = \{\alpha \mid 0 < \alpha < m, p_\alpha p_{\alpha+1} \ldots p_{m-1} = p_0 p \ldots p_{m-1-\alpha}\} \tag{1}$$

Similar pattern strings of Knuth–Morris–Pratt algorithm are shown in (2):

$$U_m = \begin{cases} 1 & ,\lambda_m \neq \varnothing \\ \min \alpha_{\alpha \in \lambda_m} & ,\lambda_m \neq \varnothing \end{cases} \tag{2}$$

The character feature values contained in the pattern string in the formula are denoted as. When a matching failure occurs between the main and pattern strings, the current positions are marked as n and m respectively. At this time, the corresponding position of the first character of the pattern string in the main string is marked as, and there is no integer to make formula (3) hold:

$$S_y S_{y+1} \ldots . S_{n-1} = p_0 p_1 \ldots p_{n-y-1}$$

This indicates that when a matching failure occurs between the main string and the pattern string, after marking the position of the first character in the pattern string, the next comparison between them will start from the character in the main string at the position. This ensures that the characters being compared between the main and pattern strings can still match the position. Otherwise, the matching efficiency will be affected.

3.2.English Simultaneous Typing and Subjective Question Scoring Module Based on KMP Algorithm

English learning is a comprehensive application, and students need to achieve a certain blind typing speed and accuracy in English teaching and training. This stage can promote the improvement of students' integrated listening and writing abilities. In previous exercises, students needed the assistance of teachers to play the corresponding English materials and manually record the duration, typing speed, and accuracy. It took considerable time for students to obtain the final data statistics [10]. In the online interactive teaching mode of English, the platform software includes relevant English training materials and automatically plays corresponding audio materials to assist students in their training. It also provides real-time feedback on students' training time and related parameters, allowing students to choose materials of different difficulty levels for practice based on their learning stage. Teachers can comprehensively understand students' learning situations based on their training data and tailor teaching content and methods.

As shown in Figure 1, it is a flowchart of the English Simultaneous Typing Module based on the KMP algorithm. The module consists of four main components: User Login System, Simultaneous Typing System, Audio File Management System, and User Management System.

The basic attribute queries of the database entities are completed through the User System. At the same time, the student's choice of difficulty level for audio materials is managed by the Audio Exercise Difficulty Management System. In this module, the entity sets are divided into four: User Information Entity

Set, Log Record Entity Set, Login Log Record Entity Set, and Audio Entity Set. Among them, the English Simultaneous Typing System is the core of the entire module, and its difficulty lies in character matching. In this paper, the module achieves character fuzzy matching using the KMP algorithm and the improved KMP algorithm mentioned earlier, aiming to improve the accuracy and efficiency of character matching.

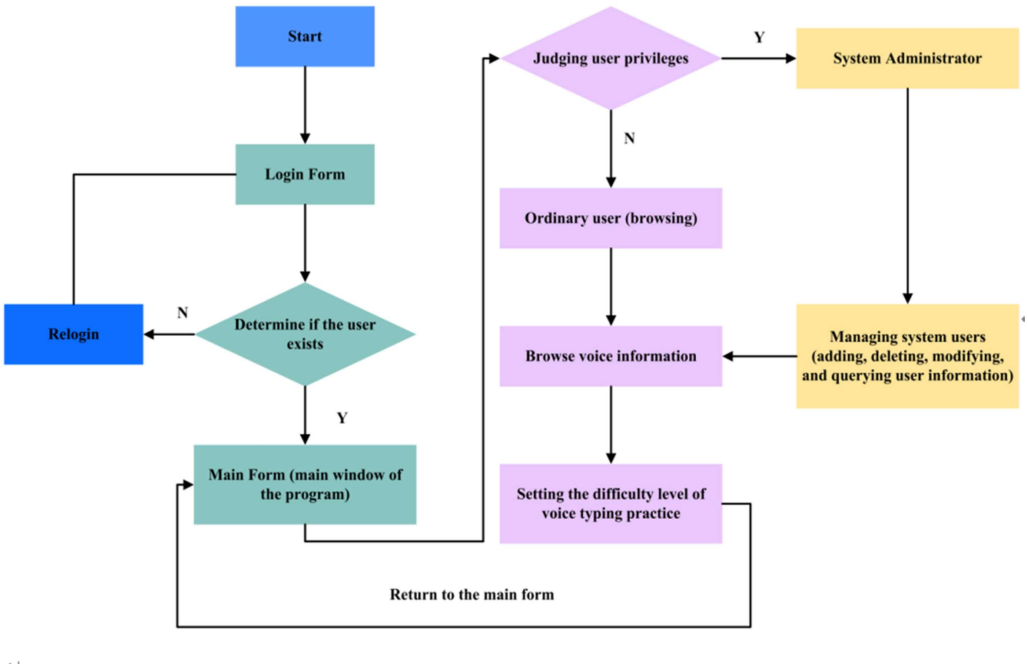

Figure 1. Flowchart of the English Simultaneous Typing Module Based on the KMP Algorithm

In addition, the online interactive teaching mode at the English emphasizes students' comprehensive English application abilities and assesses their expressive and statement abilities through subjective questions. To improve the accuracy and efficiency of subjective question scoring, this part also utilizes an improved KMP algorithm to achieve fuzzy keyword matching, thereby achieving automatic scoring on the online interactive teaching platform. The key to achieving automatic scoring for subjective questions lies in the problem of string matching between the answers entered by students and the standard answers [11,12]. Before comparing the strings, this module needs to extract the keywords in the standard answers stored in the database and set the scoring ratio for each keyword as required. This matching method is not a precise one; it means that the student's answers to subjective questions do not need to match exactly with the standard answers. The order of the keywords in both answers can have gaps; as long as the keywords match, the corresponding scores can be obtained. This matching method is more in line with the diversity of English grammar forms; different language habits and expression methods will not affect the final score as long as the meaning is the same.

In the implementation process of the English subjective question scoring module, the database must be designed to include fields containing the basic information of the English test questions. During the subjective question judgment, the algorithm first extracts the keywords from the standard and student answers and places them into separate arrays. It then loops through the arrays to sequentially extract each keyword and compare it with the standard answer. During

the matching process, the corresponding position is marked if there is a failure to match a keyword between the student's and standard answers. The next comparison will start from. If both match successfully, the matching process continues for the remaining keywords. If the matching is unsuccessful and the position variable exceeds the range, the inner loop will exit, and a new round of matching will start until it finishes.

4. English Online Interactive Mode Based on the KMP Algorithm

To validate the application effectiveness of the English online interactive mode based on the KMP algorithm, this paper compares the application efficiency of the improved KMP algorithm with two other algorithms, as shown in Figure 2. The experiment included students' simultaneous English typing practice and subjective question scoring at a certain learning places.The data in the figure demonstrates that overall, the application effectiveness of the improved KMP algorithm is higher than the other two algorithms, both in English simultaneous typing and subjective question scoring [13,14]. Regarding matching times, the improved KMP algorithm significantly reduces the number of matches while effectively reducing the matching time. This indicates that the improved KMP algorithm effectively enhances the algorithm's performance, avoiding a large number of string backtracking cases and improving the matching performance of the algorithm [15,16]. Moreover, among the three algorithms, the improved KMP algorithm achieves the highest final matching accuracy compared to the other two algorithms. This indicates that the improvement in the KMP algorithm not only enhances its matching performance and reduces the number of matches but also reduces matching errors, thereby improving matching accuracy and reducing errors.

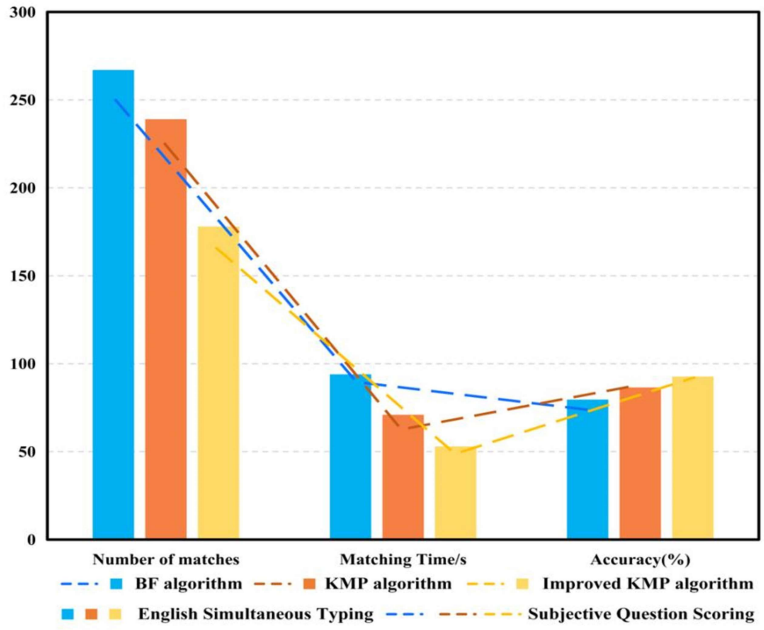

Figure 2. Application Efficiency of Three Algorithms in the English Online Interactive Mode

To further validate the application effectiveness of the English online interactive mode based on the KMP algorithm, this study conducted a statistical analysis of students' grades and satisfaction before and after applying the mode. The results are shown in Figure 3. The data in the figure indicates that after applyingthe English online interactive mode based on the KMP algorithm, students' English simultaneous typing speed has significantly improved, and their accuracy has also increased noticeably. This suggests that students and teachers can understand relevant practice data and situations from the feedback provided by the English simultaneous typing module, allowing for targeted adjustments to the training content and effectively enhancing students' comprehensive application abilities in listening and writing [17,18]. Additionally, after applying the English online interactive mode based on the KMP

algorithm, students' scores on subjective questions improved. This is mainly due to the English subjective question scoring module based on the improved KMP algorithm, which provides students with effective feedback quickly, helping them quickly understand the differences between their subjective answers and the standard answers, thereby improving their subjective answering ability and thinking. Regarding student satisfaction, most students believe that the English online interactive mode is helpful for their English learning, as it breaks the time and space constraints of English learning and practice, allowing them to access targeted guidance information at any time. Teachers can also analyze students' practice data in the system to adjust teaching content and progress promptly, laying a solid foundation for personalized teaching based on individual differences.

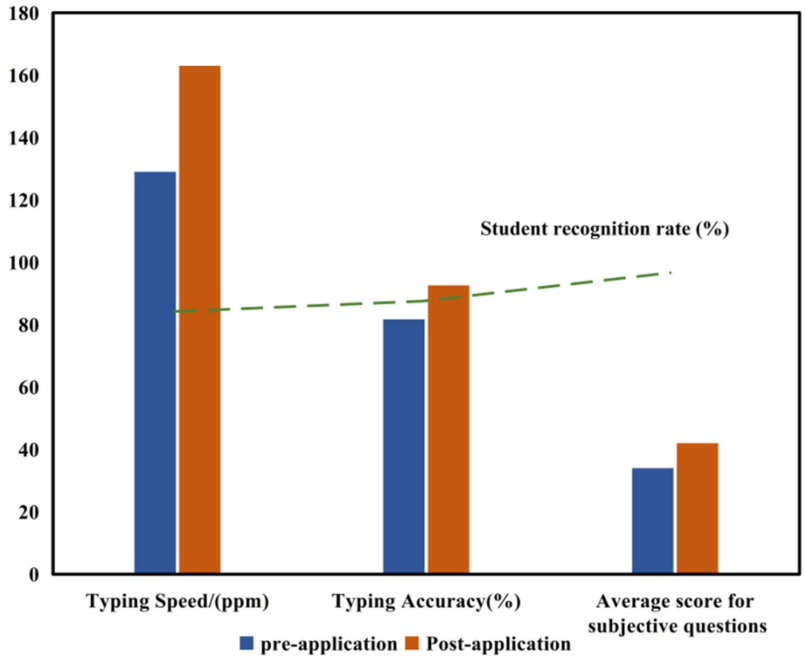

Figure 3. Comparison of Student Performance and Satisfaction Before and After the Application of the English Online Interactive Mode Based on the Improved KMP Algorithm

In summary, introducing the improved KMP algorithm in the English online interactive mode can enhance the statistical analysis of English simultaneous typing data and improve the flexibility and efficiency of subjective English question grading. This indicates that the improved KMP algorithm for character matching significantly improves by reducing backtracking and matching times, shortening matching duration, improving efficiency, and reducing errors.

5. Conclusions

As the reform ofEnglish teaching deepens, cultivating English-speaking talents with multiple skills has become a trend in English education, which is also more in line with social development needs. Compared to traditional English teaching, online interactive teaching mode is more personalized and flexible, which can help teachers achieve targeted teaching. Since English learning requires students to apply the knowledge they have learned and express their own ideas in practical situations, it has a strong subjective component, and there may be considerable errors in evaluating subjective content in the online interactive teaching mode.

This paper introduces the improved KMP algorithm in the English online interactive teaching mode, which is used to build modules for English simultaneous typing and subjective ques-

tion grading. The goal is to enhance matching efficiency through character fuzzy matching. The experimental results show that applying the English online interactive mode based on the KMP algorithm improves the efficiency of statistical analysis for English simultaneous typing data. Additionally, it enables subjective question answers to be matched with standard answers based on keyword matching, enhancing flexibility and humaneness in the answer evaluation process. Furthermore, most students believe that theEnglish online interactive mode based on the KMP algorithm reduces the time required for statistical analysis and grading, thereby improving the efficiency of English learning and practice and promoting learning quality and effectiveness.

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