Research Article

QA Learning System-Based English Listening and Speaking Ability Improvement Strategy

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For most students, English learning is a strong affirmation of their self-learning ability, while not mastering effective learning methods and strategies makes most students doubt their language learning ability. One of the most important abilities in English learning is listening and speaking ability. How to enhance listening and speaking ability is quite important to improving English level. In this context, this study analyzes the problems in English listening and speaking teaching by understanding the current situation of students’ English listening and speaking training. On this basis, this study proposes a question-answering (QA) system based on deep learning to improve English listening and speaking ability. The results show that the proposed method in this study can not only effectively improve the accuracy of students’ answers but also improve their interest in English learning. The new method can effectively improve English listening and speaking ability and provide technical reference and method reference for the improvement of English listening and speaking ability.

1. Introduction

With the advent of the era of big data, study documents are rapidly becoming electronic and digital, and the amount of information on the Internet is increasing exponentially. It is more and more convenient for people to obtain information through network technology, but it is very difficult to obtain useful knowledge from massive information [1]. In information acquisition, a search engine is a very convenient tool, which can solve the retrieval needs of many users. However, in the acquisition of knowledge, the drawbacks of search engines are also obvious, search engines are given by the user a keyword as a limited screening of the web page, but to further obtain the required information, it is necessary to manually browse the web page one by one to find. The performance of search engines largely depends on the quality of keywords, accurate and concise keywords are very necessary, which put forward requirements for the user’s ability to summarize. Therefore, in the current background, the search engine is difficult to meet people’s requirements for accurate knowledge acquisition, question answering (QA) system is born because of luck [2]. Question answer (QA) is a new information retrieval method that allows users to ask questions in natural language and search and return exact answers or text fragments containing answers from monolingual or multilingual documents. When users use the question answering system, they can describe the questions according to their requirements. The system will extract the user’s intention according to the questions, and select the answers from the mass knowledge and return them to users. To some extent, it solves the problem that users are difficult to sum up their intention as keywords, making the system more accurate to capture the user’s intention. At the same time, it can also filter the results automatically through the system and provide more accurate and concise information to the system users [3].

With the rapid development of the Internet era, trillions of terabytes of data are generated every day. As computer storage technology changes rapidly, the most important task facing data is how to efficiently and accurately access, rather than storing and memorizing. There are many traditional search engines nowadays, such as Google, Baidu, Bing, and so on. However, due to the huge amount of data, a simple query can only display the search
results according to its word matching method, instead of giving users the most desired answer. Therefore, people want computers to understand their needs, rather than stay in the literal meaning of keywords. Under such rigid demands, more and more artificial intelligence services have been developed, which includes the topic of this paper: QA learning system [4, 5]. Answer selection is based on an important component of a QA system, since the purpose of a QA system is to find an accurate answer to a question, not to run a second query through the relevant documentation. Therefore, the answer selection will further analyze and refine the relevant statements of the question, so as to locate the candidate answers, and sort the candidate answers from top to bottom according to the weight value. This sorting method can be roughly divided into two kinds: One is based on logical analysis methods and the other is based on statistical methods. The former mainly compares similarity through semantic grammar information and vector features, and sorts by similarity. The latter method mainly calculates the score of candidate answers through some characteristic values, and the key of this method is to design a reasonable model to accurately combine each characteristic weight of candidate answers and calculate the corresponding probability value of each candidate answer. Horizontal comparison of answer selection sorting methods based on statistics and analysis shows that the analysis method has higher accuracy, while the statistics method is more efficient.

In the process of improving students’ own ability, good learning strategies can improve students’ learning efficiency. This raises a question: Is it because students’ English performance and learning ability are improved after using good learning strategies, or because students can listen and read in the long-term learning process, and then they will develop good learning strategies naturally? As an important communicative tool in the world, English is of great importance to the acquisition and even application of knowledge [6]. We combine the results of previous studies on learning strategies to find out the psychological characteristics of English learners and to deal with the problems in the process of English level examination. The application of learning strategies of English learners is investigated through in-depth techniques. The main tools adopted include: a questionnaire of learning strategy based on learning strategy, discussion with senior English teachers in colleges and universities, etc.

The effect of English classroom teaching will indirectly affect students’ English reading and writing ability [7, 8]. English classes pay attention to skills and practice, how to enhance students’ communicative consciousness should be given priority, students dare to speak, dare to express their ideas is the fundamental purpose of English learning. Only when students want to use English to convey information and carry out emotional communication can they have a stronger motivation and interest in learning English. The English course is open to all students and aims to comprehensively improve students’ interest in learning English. Psychological tests show that in the process of knowledge learning, people acquire knowledge mainly through vision and hearing, accounting for more than 80% of all knowledge. Therefore, teaching from listening not only conforms to the law of teaching but also accords with the law of language learning. At present, most students can only learn English pronunciation and intonation by listening. Listening is the beginning of interpersonal communication, but also the primary condition of interpersonal communication, understanding can make learners more confident to communicate with others.

Students’ oral English practice time is less, most students do not have the opportunity to contact foreigners, naturally there is no English communication environment. The only English communication is in class, and there is no atmosphere for communication at home. In today’s quality-oriented education, exams are still the main means to measure and evaluate students. But the student loses the opportunity to carry on the oral communication training in the classroom, and also neglects the cultivation of the listening and speaking ability [9]. The level of teachers’ oral English ability is uneven, and the requirements for students’ oral English are relatively low, which makes the oral English level of many junior middle school teachers decline. Daily oral communication basically exists in class and is limited to teaching, which makes teachers’ oral English play has certain limitations, and ultimately makes teachers’ oral English level affect the development of students’ oral English ability. Nearly one-third of Chinese college English learners can say that they have encountered difficulties in learning English. Many students spend a lot of time and energy, but the result of English learning is still not ideal. Although there may be complicated reasons in all aspects, the most fundamental reason is that students do not have effective English learning methods and strategies.

Therefore, it is most likely that college English learners do not have effective learning strategies and cannot learn English. College English teaching requirements have been implemented in China for more than 10 years. As for the English language knowledge, application skills, learning strategies, and cross-cultural communication mentioned in the requirements, as well as the qualitative and quantitative description of college English teaching objectives, students with learning difficulties in ordinary colleges and universities are still unable to implement them well [10]. Among them, there is still a long way to go to master learning strategies and improve English listening and reading ability. Studying English learning strategy is not only the addition to the theoretical teaching and learning theory and reference, the most important thing is that in the actual level of a large number of college English learners to provide effective learning methods, and solve in the real sense to a certain extent because no master learning strategies are leading to the problem of insufficient long-term reading and listening to English ability [11]. In the face of this situation of English learning, this research is based on this background to explore. (1) QA system is applied in the field of English listening and speaking ability improvement for the first time in this paper. (2) The method in this study not only has a solid theoretical foundation but also has broad application prospects.
2. Related Work

At present, Learning English as a second language is very common in China, which shows the importance of improving English listening and speaking ability. In order to improve English listening and reading ability, we must have a full understanding of the academic research status. Foreign scholars mainly study learning strategies from two aspects, which investigate the effectiveness of learning strategies in detail. The first aspect is the common problem, what are the learning strategies of excellent learners? The second aspect is to explore the practicability of good learning strategies possessed by excellent learners through data visualization. People with excellent English listening and reading skills generally have some commonalities [12, 13]. In the 1990s, with the popularization of scientific statistical technology, researchers adopted more scientific methods compared with the early days, and empirical research was generally applied. After large sample data processing, researchers can more firmly explore the differences between learning strategies and English listening and reading ability.

QA systems have a long history of research [14]. As early as the 1960s, QA systems were used to solve the problems of replying to the NBA. But some of the early research work has been stuck in the template matching and expert system level, QA system is rule-driven to answer people’s questions. With the continuous development of natural language processing, the technology of the QA system has also been greatly improved [15]. The research methods can be divided into generative question answering and retrieval question answering. The generative QA model usually performs training on a large number of question data sets to fit the correlation between questions and answers, so as to complete automatic replies to unknown questions. Retrieval QA generally matches the questions entered by users with the questions in the knowledge base prepared in advance. When a highly similar question is matched in the knowledge base, the answer to the question will be replied to the user. Literature [16] created and published a QA dataset in the insurance field, and used different neural network structures on this dataset to study the ability of deep learning to answer non-factual questions, proving the feasibility of using deep neural network to process questions and answer system. This approach uses a fast retrieval algorithm to perform a preliminary screening of huge data sets, and then uses a high-performance deep learning network to perform semantic matching of the preliminary screening answers. It not only ensures the efficiency of question answering system operation but also has a good quality assurance, which has been widely concerned by the industry.

In addition to these studies, domestic leading Internet companies have also set up QA systems, such as JIMI, a new member of JD’s online customer service team, which was launched in 2012. Ali Xiaomi serves millions of customers every day and can solve 85% of the problems in the daily shopping process. As the leading Chinese search engine, Baidu also relies on the natural advantages of its search engine natural processing technology to create an intelligent QA system. Unlike JD and Ali, Xiaodu’s prototype is an interactive smart speaker for the home. Traditional QA systems mainly use statistical machine learning and natural language processing methods. Methods based on statistical machine learning usually define a series of lexical and other related features, and use the classification confidence of the classifier as the confidence of the answer selection. The natural language processing (NLP) based QA method usually makes a superficial analysis of the sentence to obtain the superficial syntactic information of the sentence, and then calculates the similarity according to the dependency syntactic tree between the question and the answer, so as to improve English listening and reading level [17, 18]. The answer selection model in traditional question answering system is highly dependent on manual, which requires manual annotation of a large number of data, which is not conducive to the improvement of English listening and reading level.

In recent years, deep learning has achieved a series of achievements in improving English listening and reading levels [19, 20]. Among them, the convolutional neural network (CNN), recurrent neural network (RNN), long and short-term memory network (LSTM), and attention mechanism are outstanding. In the process of image data, the width and height of the convolution kernel set in the convolution layer are the same. However, in processing text-like data, it is necessary to ensure that the convolution kernel width and word vector have the same dimension. The reason is that, in the input layer, each word is represented by a row vector. In feature extraction, since words are the minimum granularity of sentence representation, if the width of the convolution kernel is smaller than the dimension of word vector, the setting of words as the minimum granularity in sentence representation is destroyed. The height of the convolution kernel can be set as required. Secondly, as the input sentence, the semantic relevance between adjacent words is large. Therefore, in the convolution calculation of a certain word, the semantic and word order information of the word can be considered at the same time. The purpose of pooling is to filter irrelevant information or some unimportant information contained in sentences after convolution operation, so as to make important information features more prominent. Therefore, at the pooling layer, it is necessary to reduce the dimension of each feature vector after convolution. As we all know, an inevitable problem in RNN is how to solve the long and short-term dependence between data. LSTM is the network structure proposed for such long and short-term dependence. At present, the LSTM network is widely used in natural language processing, video understanding and target detection, deep reinforcement learning, and other fields. However, in an LSTM network, the cell internal control logic is more complex. Each unit of the LSTM network contains multiple logical control structures, which process the sequence of information contained in sentences. In addition, each base unit can use a logical control structure to determine whether previous input information is added to the current information.
A kind of new CNN model has put forward in [21]. The authors of [22] established a new answer selection model for the lexical gap between questions and answers. They used a bidirectional LSTM encoder and decoder to bridge the lexical gap between questions and candidate answers, and improved the effect of the model by gradually focusing on the mechanism. The authors of [23] proposed a novel cyclic unit model (N-GRU) with review gating. This model applies the review mechanism to the gated cyclic unit, so that the previous information can be checked periodically, and the process of checking does not affect the gated unit. Finally, experiments show that this method can effectively improve the performance of the English answer selection model. To handle answer selection question, the authors of [24] proposed an interactive knowledge network enhancement model for answer selection task, which interactively learns sentence representation of question pairs by introducing an external knowledge graph existing outside the question. In this way, you can refer to more comprehensive sentence features when choosing answers, thus improving your English listening and speaking ability. Compared with traditional deep learning methods, the above improved deep learning method performs better in training model effect, but it often needs more data for training. In addition, in the process of training, a large number of labeled data need to be manually labeled, while the semi-supervised deep learning method can use unlabeled data for model training [25]. Therefore, more and more scholars begin to study the improvement of English listening and speaking ability based on semi-supervised deep learning. As a QA system is composed of multiple modules, the CNN model is used as one of the modules in the system for modeling analysis in this paper.

3. Deep Neural Networks for English Listening and Speaking Ability Improvement

3.1. Feedforward Neural Network (FNN) Introduction. FNN is also called multi-layer perceptron (MLP). The objective of FNN is to obtain a mapping function. The parameters propagate one way from the input layer to the output layer. Different from the recursive neural network, FNN does not form a directed loop inside. Each neuron is arranged in layers. As the simplest neural network at that time, each neuron is connected to the upper layer, and the output of the upper layer continues as the input of the lower layer, and there is no feedback between layers. The multi-layer perceptron neural network is given in Figure 1.

When FFNs are extended to include feedback connections, they are called RNNs. In addition, FNN has some relevance to neuroscience. We can think of the network layer as a number of parallel operation units, each representing a mapping between vectors and scalars. In some ways, each unit is like a single neuron. In general, the research of FNN has a vital impact on the research and development of CNN and LSTM. Due to the shallow network layer and the use of linear activation units, the early fully connected neural network models are often difficult to improve English listening and speaking ability in the context of big data.

![Figure 1: The typical schematic diagram of fully connected neural network.](image)

3.2. Deep CNN Model Introduction. CNN model adds convolution layer and pooling layer to form the deep CNN model, which is shown in Figure 2. It only shows the schematic diagram of the CNN algorithm in this paper, it is impossible to know how many convolutional layers and pooling layers there are. In the algorithm of this study, we set two layers of pooling layer and two layers of convolution layer, respectively.

The calculation process of convolution is shown as follows:

\[
\text{CONV}_{ij} = \sum_{m=1}^{m-1} \sum_{n=1}^{n-1} u_{ij} \times (w + b) (i = 1, 2 \cdots m - 1; j = 1, 2 \cdots n - 1),
\]

where \( u_{ij} \) is the input image, \( m \) and \( n \) are the size of the input image, \( w \) is the size of the convolution kernel, and \( b \) is the bias constant of the convolution kernel. \( \text{CONV}(ij) \) is the characteristic graph output after the convolution operation. CNN adds an activation function layer to the network and analyzes the model better by adopting the feature mapping method of nonlinear function. Then, the activation functions are introduced one by one as follows.

The sigmoid function is

\[
f(x) = \frac{1}{1 + e^{-x}}. \quad (2)
\]

The tanh function is

\[
f(x) = \frac{e^x - e^{-x}}{e^x + e^{-x}}. \quad (3)
\]

The ReLu function is

\[
f(x) = \max(0, x). \quad (4)
\]

Since formulas (2)–(4) are activation functions, the value range of its independent variables is the whole real number, and the range of its dependent variables is \([-1, 1]\). The full name of ReLU function is rectified linear unit. The function is one of the commonly used activation functions, which is characterized by low computational complexity and no exponential operation. However, it is worth explaining that the ReLU function has certain defects in the calculation process. When the data passes through the negative range of ReLU function, the output value is equal to 0. The Leaky-ReLU function can solve the above problem.

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The corresponding equations of Sig and Tanh are as follows:
\[
\text{sig}(x) = \frac{1}{1 + \exp(-x)}
\]
\[
\text{tanh}(x) = \frac{\exp(x) - \exp(-x)}{\exp(x) + \exp(-x)}
\]
Here, \( x \) is the input.

The QA system involves a wide range of fields, among which the key technologies are knowledge extraction and representation. These are all areas that need to be studied in order for us to have a better intelligent question-answering system. And no matter we make a major breakthrough in any field, not only for intelligent question answering systems, but also for other fields, including text classification, recommendation systems will have a considerable role in promoting. The deep-learning-based QA system for English listening and speaking ability improvement is given in Figure 3. It mainly includes CNN model, vector representation, and so on.

4. Experimental Results and Analysis

4.1. Experimental Data Introduction. In the research, a series of parameters will be involved, which will give a better explanation of students’ application of learning strategies in the process of English learning. The basic parameters we cover are as follows. Answer score: answering question mark is divided into two parts, the first part is about English learning strategy questionnaire scores, according to the score will be divided into groups and two group, low and high group and the low group of each participant in the English learning strategies questionnaire score and can according to the six dimensions of the questionnaire is divided into 32 component scores. The second part is the score of English problem-solving strategy questions. The questions are designed in accordance with scientific methods, which are divided into reading and listening questions.
Students from one province were selected as the research subjects. After considering the English learning of the subjects, the subjects were selected. A number of students were randomly selected based on the CET4 scores of the subjects. All the students were non-English majors because they had received less professional English training and were closer to natural learning. We focused on exploring the influence of the application level of English learning strategies in the process of solving English problems. Therefore, the focus was on studying the differences between high and low groups. The framework system of the CNN model applied in this study is shown in Figure 4. As the method in this study is a conventional CNN model, its structure and parameter setting can be referred to Figure 4.
4.2.Experimental Results Analysis. First of all, Figure 5 gives the accuracy of the different methods (the proposed method, conventional QA system, PCA, random forest, L1 regularization, Pearson correlation, and LASSO) regarding a different number of questions. As can be seen from the figure, the accuracy of the method proposed in this paper is always very high. With the increase of the number of questions, the accuracy decreases slightly, but the model performance is still very good, which proves the effectiveness of the proposed method in improving English listening and speaking ability. In contrast, the rest of the algorithm is not as accurate as the proposed method whether the number of questions is small or large. This may be because these models are shallow models, random forest is a classic machine learning model, and the method in this paper is based on the CNN model, it is a deep learning model. Hence they are selected as the comparison algorithms.

To further demonstrate the effectiveness of the proposed method, we randomly selected 8 English listening and speaking questions from the database. Figure 6 shows the confusion matrix diagram accuracy of English answers by conventional QA learning system and deep learning-based QA learning system regarding 8 English listening and speaking questions. As can be seen from the figure, the method proposed in this paper can achieve higher accuracy in English test performance, no matter the accuracy of a single question or the average accuracy. Thus, the stability and effectiveness of the proposed method for English listening and speaking ability improvement are verified.
In addition to improving the accuracy of English answers, the proposed method can further improve learners’ interest in English listening and speaking. We can figure out from Figure 7 that those who chose to be very interested increased from 21% to 35%. The number of people who chose to be more interested in and increased from 30% to 48%. The number of students who choose not interested decreases from 32% to 11%. The number of students who choose not interested at all decreases from 17% to 6%. This showed that the new QA learning system is effective.

In order to prove the validity of the proposed method from another angle, primary school, secondary school, and university students from 2015 to 2021 were selected to calculate the improvement of English listening and speaking ability after training in the designed QA learning system. As can be seen from Figure 8, for students at different stages, the methods mentioned above can improve their English listening and speaking ability to a certain extent. But there is no pattern to the degree of improvement. The highest increase was 69.2 percent for primary school students in 2018, and the lowest was 5.4 percent for secondary school students in 2021. However, the improvement degree of middle school students certainly is the least. The main reason is that there is relatively less time for training with the proposed system in middle school homework tasks, which affects the improvement effect of the model.

Since the six dimensions of the questionnaire in this study are divided into 32 component scores. In order to verify the accuracy of this method in describing the effects of different dimensional variables on English listening and speaking ability, the contribution values of different variables to English listening and speaking ability are shown in Figure 9, in which the figure above is the contribution value to listening and the figure below is the contribution value to expression ability. As can be seen from the figure, the QA learning system designed in this paper can accurately identify variables 9 and 32 that have the greatest impact on English listening ability. At the
same time, the variable that has the greatest influence on English expression ability can also be identified as variable 31. These results are consistent with the actual experience, thus demonstrating the reliability and practicability of the method in this paper.

5. Conclusions

With the rapid development of artificial intelligence, English learning has become an important task of artificial intelligence technology. The basic task of English test answer selection is to select the most matching answer from the candidate pool for a given question and answer pool. The focus of this study is to improve the conventional QA learning system based on deep neural network, then the proposed method is applied to English learning so as to improve the accuracy of English testing and ultimately improve English listening and speaking ability.

In the process of completing the study, this study mainly focused on listening and speaking ability in English learning. However, this paper only selected two of them. In the future, exploring the differences between more modules and specific ways for English learners to improve their learning strategies is worth exploring, which provides some reference for English learning. Although the method proposed in this paper has achieved good results, the research in this paper does not consider the student’s personality, living habits, and other factors in the process of modeling. This will be the focus of future research.

Data Availability

The experimental data used to support the findings of this study are available from the author upon request.

Conflicts of Interest

The author declares no conflicts of interest regarding this work.

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