Research Article

Evaluation Method of the Metacognitive Ability of Chinese Reading Teaching for Junior Middle School Students Based on Dijkstra Algorithm and IoT Applications

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In view of the poor quality of Chinese Reading Teaching in junior middle school, this paper puts forward the metacognitive ability evaluation method of Chinese Reading Teaching for junior middle school students based on Dijkstra algorithm, constructs the Chinese Reading Teaching management system for junior middle school students, optimizes the Chinese reading evaluation indexes for junior middle school students, and optimizes the metacognitive ability evaluation algorithm of Chinese Reading Teaching for junior middle school students combined with Dijkstra algorithm. Finally, the experiment proves that the metacognitive ability evaluation method of Chinese Reading Teaching for junior middle school students based on Dijkstra algorithm has high practicability in the process of practical application, can better ensure the teaching quality, and can fully meet the research requirements.

1. Introduction

The Dijkstra algorithm has a hot topic in the field of teaching in recent years. Modern society is a learning society. In the era of the knowledge economy, people need to constantly learn new knowledge, and it is of far-reaching significance to cultivate students’ autonomous learning ability. The evaluation method of metacognitive ability of Chinese Reading Teaching for junior middle school students emphasizes learners’ own initiative, enthusiasm, and sense of responsibility, and dependent learning is a common learning model in Chinese classroom teaching [1]. Therefore, changing the traditional teaching mode, taking students as the main body and teachers as the leadership, giving full play to students’ enthusiasm and initiative, and cultivating students’ ability to bear certain learning responsibilities in classroom teaching are the keys to gradually realizing the transition from dependent learning to the evaluation of metacognitive ability of Chinese Reading Teaching of junior middle school students [2]. In the process of cultivating junior middle school students’ Metacognitive Ability in Chinese Reading Teaching, we must let students master and actively use certain learning strategies. Learning strategies are divided into cognitive strategies and metacognitive strategies [3, 4]. The IoT will create a huge network of billions or trillions of “Things” communicating with each other. The IoT is not subversive revolution over the existing technologies, it is comprehensive utilization of existing technologies, and it is the creation of the new communication modes. The IoT blends the virtual world and the physical world by bringing different concepts and technical components together: pervasive networks, miniaturization of devices, mobile communication, and new ecosystem. In IoT, applications, services, middleware components, networks, and end nodes will be structurally organized and used in entire new ways. The cultivation of metacognitive ability in Chinese Reading Teaching for junior middle school students is also composed of cognitive strategies and metacognitive strategies. In addition, the cultivation of affective strategies is also an indispensable part of the cultivation of metacognitive ability of junior middle school students’ Chinese Reading Teaching. Therefore, the
2. Evaluation Method of Metacognitive Ability in Chinese Reading Teaching for Junior Middle School Students

2.1. Evaluation Index of Chinese Reading Teaching System for Junior Middle School Students. Chinese reading has a broad practical situation, reading materials with different themes, different reading purposes, different material organization forms, different reading material manifestations, and different reading equipment. So many differences constitute a diversified reading situation [5]. At present, more and more researchers focus on the nonlinear, interactive, and multimedia reading brought by the change of resource performance and organization mode. The research on linear, textual, and Chinese reading, which is the closest to the traditional paper form, is outside the halo of the spotlight. In fact, this form of Chinese reading is the most common form [6]. This paper focuses on this kind of Chinese reading close to the traditional paper form. Therefore, in the context setting, we also need to consider the difficulty of reading materials and learners' individual efforts. The comprehensive understanding state classification model can be used as a reference for the setting of Reading Context in this paper, as shown in Figure 1.

Basic reading ability refers to the specific embodiment of students’ cognitive ability in the discipline and the ability embodiment of the general process of thinking activities [7]. From the perspective of cognitive theory, psychological cognitive processes can be divided into six categories: memory, understanding, application, analysis, and comprehensive evaluation (Figure 2). Cognitive theory emphasizes the seriality and systematicness of cognitive process in the discipline.

From the perspective of reading teaching research, the evaluation of reading ability can be analyzed from two aspects: vertical ability development and horizontal ability composition. From the different stages of reading ability development, it is divided into early reading stage, formal reading teaching, text decomposition, transition period, critical interpretation comparison, and multidimensional perspective [8]. The development of reading ability is basically consistent with human development. Learners’ performance in reading learning shows a development trend from simple to abstract, from surface to profound, and from single thinking to multidimensional perspective. There are also corresponding changes in the corresponding observable indicators. The evaluation of reading ability is usually carried out in the context of “learning.” Therefore, the analysis of reading comprehension adopts more universal techniques [9, 10]. In order to clearly reproduce the evaluation theory and representative technology of each era, its development state is described based on the timeline, as shown in Figure 3.

Based on the above statements, the situation of the analysis and evaluation of Chinese reading Dijkstra algorithm in this paper is as follows: digital text reading materials, such as e-books, PDF documents, and CAJ documents, and static text content web pages: the reading materials have a certain depth [9]. It is the scientific knowledge or research results of a subject field or theme: learners are required to mobilize more cognitive and metacognitive elements to process digital materials. The main purpose of reading process research is to understand the rules and characteristics of learners’ reading. Reading, as a continuous cognitive activity in a certain time interval, requires learners to process and process the information through perceiving the text information, mobilizing mental strategies, and obtaining the understanding of the text meaning [11]. The research on reading process in different fields adopts different methods to interpret the characteristics and laws of reading, learning from the perspectives of psychological model of reading process, development law of reading cognition, and characteristics of reading behavior.

2.2. Evaluation Algorithm of Junior Middle School Students’ Cognitive Ability in Chinese Reading Teaching. Most studies on the composition of reading ability include different levels of ability. In fact, this is an improving level of reading ability. In fact, the research and understanding of the structure of reading ability should not be limited to one aspect but should focus on the systematic development of reading ability [12]. Therefore, it is necessary to study the relationship between different development levels of reading ability. Some researchers use the continuum thinking method to study different levels in the process of reading, as shown in Figure 4.

In the analysis and evaluation of learners’ reading process, whether classroom observation is dominated by teachers’ experience or tracking the small changes of eye movement in the reading process with modern technology, learners’ attention characteristics, reading speed, and self-regulation characteristics are important aspects to judge learners’ reading ability [13]. Combined with these studies, the content system of Chinese reading process evaluation is established, as shown in Table 1.
Figure 2: Structure of Chinese reading ability.

Figure 3: Development of Chinese reading learning evaluation technology.

Figure 4: The different hierarchies in reading.
The evaluation of learners’ reading comprehension results is usually generalized to the evaluation of reading ability. According to the purpose of Dijkstra algorithm, the evaluation of learners’ reading comprehension can be divided into goal-oriented evaluation and ability-oriented evaluation [14]. The former attaches importance to learners’ understanding and mastery of learning content, while the latter emphasizes learners’ ability at reading. Because of their different ideas, there are corresponding differences in the evaluation contents and methods. According to the data marked by readers and visual graphics, it can be found that although learners’ reading input is inconsistent on different learning days, learners read and learn the literature content on each learning day [15]. In order to distinguish learners’ efforts in Chinese literature reading and autonomous reading strategies, the Dijkstra algorithm of each learner is taken as a set, and the clustering screening method is applied to analyze the input state of learners. The specific methods are as follows: the student set is recorded as S:

$$S = [s_1, s_2, s_3, \cdots, s_n].$$

From the release of the task to the end of the task n, the learning day LD is recorded as

$$LD = S / 2 |s_n - n|. \quad (2)$$

In the process of reading, as long as a mark falls within these three intervals, it is regarded as having reading activities at this stage. The frequency of reading activities is f, and the calculation method is

$$F(s_n) = \sum_{n=0}^{N} LD - s_n. \quad (3)$$

In the analysis of reading time management based on the Dijkstra algorithm, it is still difficult to accurately obtain the above two data. Our solution is to calculate the time used for complete reading of a paper based on the average reading speed $r_s$ of learner $S_i$, which is recorded as

$$S_i \cdot RT = F(s_n) - RRT \sum_{i=1}^{n} S_i - \frac{WNP}{S - r_s}. \quad (4)$$

Calculate the time difference between the initial mark $D_n$ and the last mark $D_K$, and record the time $LT$ to obtain the actual cost as

$$S_i \cdot ST = D_n - \sum_{i=1}^{n} S_i \cdot RT + D_K + LT. \quad (5)$$

The time use efficiency $E$ of student is recorded as

$$S_i \cdot ET = \frac{ES + D_n}{S_i \cdot ST - S_i \cdot RT}. \quad (6)$$

According to the above basic ideas of Dijkstra algorithm analysis of reading comprehension level, Dijkstra algorithm analysis is carried out on learners’ reading comprehension level at different levels $C_m$. Firstly, according to the basic assumptions in text analysis, the concept set in text structure and the relationship between concepts are recorded as follows:

$$C_m^L = [(C_1, C_2), (C_3, C_4), (C_5, C_6), \cdots]. \quad (7)$$

The concept set of learners’ knowledge extraction and the relationship between concepts $C_m^L$ and $CR^L$ are recorded as follows:

$$C_m^L = [(C_1, C_2), (C_3, C_4), (C_5, C_6), \cdots]. \quad (8)$$

Thus, learners’ basic understanding level can be recorded as

$$ACL(L_i) = \frac{CR^T \cap CR^L}{S_i \cdot ET(CR^T + CR^L)}. \quad (9)$$

The analysis based on the Dijkstra algorithm provides a multidimensional perspective for us to deeply understand learners’ reading characteristics. From the group level, we
can understand the rules of learners’ reading time and the basic characteristics of information processing. From the individual level we can analyze the input state of individual reading process in the natural state, and find the personalized reading characteristics of learners [7]. These characteristic data can help us use the Dijkstra algorithm to finely describe learners’ reading process from the aspects of attention control, time management, reading strategies, and so on. Evaluation ability is the individual value judgment made by students in the process of reading or after reading activities according to certain standards. Appreciation ability refers to students’ ability to judge and appreciate all kinds of reading texts [8]. It cultivates students’ specific evaluation and appreciation of the content, form, and style of different reading texts, so as to distinguish right from wrong, good from bad, beautiful, and ugly; Creative ability refers to students’ creative reading ability, that is, to read, transfer and apply according to a certain creative purpose, trigger from reading, and get new creative ideas or understanding. Obviously, these three reading abilities have the characteristics of subjectivity. In the process of interpreting, evaluating, and appreciating specific texts, readers must be based on the objectivity of reading ability and understanding ability [17]. It can be said that the objectivity of reading ability and understanding ability constructs a reading “understanding field” for evaluation ability, evaluation ability, appreciation ability, and creativity, as shown in Figure 5.

Mastering that reading ability is a developing level. It is possible to purposefully train students’ reading ability and cultivate students’ corresponding reading ability in the actual reading teaching. In the process of reading teaching, we can carry out the teaching of reading knowledge, and it is possible to organically integrate knowledge and ability, process and method, emotional attitude, and values in reading teaching [18–20]. It cannot only cultivate students’ reading ability but also train students’ reading quality.

2.3. Realization of Cognitive Ability Evaluation of Chinese Reading Teaching for Junior Middle School Students. The modern reading principle holds that in the process of reading, the author, the text, and the reader are three-dimensional
interrelated. Among them, the author and the text are the direct generation and creation process, while the reader and the text are the indirect communication process. The reader can only interpret the text by virtue of the externalized form of the text. Learning evaluation is the core component of Dijkstra algorithm learning. Dijkstra algorithm learning is a learning activity and growth process for learners [21–23]. Appropriate strategies and methods are adopted to activate learners’ explicit and implicit learning behavior characteristic data; meet learners’ personalized learning needs through analysis, intervention, and the provision of learning services; form new learning methods; and help people’s all-round development. The essence of Dijkstra algorithm learning is to use analysis technology to integrate into the learning process, trying to promote “self-awareness and self-transcendence of human individuals and human beings as a whole.” It can be seen that Dijkstra algorithm learning is based on data, accurately measures the learning process and state, awakens learners’ self-awareness through continuous evaluation, realizes learners’ control over self-learning, and achieves the ultimate goal of “learning to learn.” The specific model is shown in Figure 6. Text is a high unity of speech content and form. If readers want to get a correct understanding of the text, they must interpret the text objectively and correctly, that is, reading standardization. Chinese reading ability includes language decoding ability, organization and coherence ability, pattern discrimination ability, screening and storage ability, language sense ability, and reading transfer ability. It is further pointed out that reading ability changes with age. The main components of reading ability are language decoding ability, organizational coherence ability, generalization ability, and evaluation ability. The reading process is also analyzed as Table 2.

Table 2: Analysis of Chinese reading process.

| Category                        | Subactivity name                                                                 |
|---------------------------------|----------------------------------------------------------------------------------|
| Paper microunderstanding reading| Understanding of words and sentences in papers                                   |
|                                 | Understanding of context and coherence reasoning                                  |
| Macrocomprehension reading      | Understanding of paper layout                                                    |
|                                 | Understanding of writing intention and expression                                 |
|                                 | Grasp the key information in the paper                                           |
|                                 | Inference, organization, and construction of paper potential information          |
| Evaluation reading              | Paper evaluation and appreciation                                                |
| Divergent reading               | The unique comprehension and transfer of the paper                                |

Table 3: List of junior middle school reading language test.

| Category       | Investigation contents | Sub skills                                                                 |
|----------------|------------------------|-----------------------------------------------------------------------------|
| Understanding reading | Microunderstanding | Understanding of words                                                      |
|                 |                        | Semantic understanding, understanding of word meaning in the paper, analysis of word meaning, understanding of morphology, understanding of classical Chinese words |
|                 | Sentence comprehension | Understanding of sentence meaning, paper sentence, sentence structure, sentence relationship, identification of wrong and sick sentences, and understanding of classical Chinese sentences |
|                 | Understanding of partial content of the paper | Literal understanding and inferential understanding of the local content of the paper |
| Macrounderstanding |                        | The understanding of the overall content of the paper, the structure of the paper and the writing method |
| Evaluative reading | Evaluate | Evaluation of the paper                                                      |
| Applied reading   | Application            | Application of new knowledge gained by reading                              |
| Retentive reading  | Keep                   | Maintenance of partial and overall content of the text                      |
| Fast reading      | Speed reading           | Fast reading comprehension and reading retention                            |

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Table 4: Basic reading skills in junior middle school.

| Attributes related to the whole text | Sub skills (16) |
|------------------------------------|-----------------|
| Low frequency words: there are many low-frequency words in the whole text. Check your understanding of low-frequency words |
| Specify the location of the prompt information: the location of the answer to the question in the text is clearly formulated, that is, text mapping processing |
| Overlapping vocabulary knowledge information location: find the problem and overlapping vocabulary in the text by scanning the passage to obtain information. Text mapping processing |
| Inconspicuous position of information: it means that the information required to answer the question cannot directly correspond to the passage, and the subjects’ understanding of the material is assessed. |
| Corresponding text mapping processing and coding processing. |
| Low frequency vocabulary: the correct choice belongs to low-frequency vocabulary. Check the knowledge of low-frequency vocabulary |
| Word overlap: the correct choice can directly find the overlapping words in the short text, corresponding to the text mapping processing |
| Beyond the scope of the passage: the correct choice information exceeds the information clearly given in the passage. Corresponding text mapping processing |
| Reasonable interference item: the wrong option seems reasonable, but it is too wide or too narrow. |
| Authenticity processing corresponding to evaluation response options |

## Cognitive model of reading ability in junior middle school

A study on cognitive diagnosis and evaluation of junior middle school students' modern text reading comprehension ability

Diagnosis test preparation

Study I

Constructing the cognitive model of junior middle school students' modern text reading comprehension

Cognitive attribute analysis and demonstration, hypothesis of attribute hierarchical relationship

Establishment and revision of Q matrix, item compilation and text quality analysis

Quality analysis and statistical analysis of diagnostic results of model applicability test

Making of diagnosis report card and experimental verification of the effectiveness of feedback information

Feedback report a study and information feedback

Study II

Diagnose and analyze the data and test the quality of the diagnosis results

Diagnosis and analyze the data and test the square library and effectiveness

Making of diagnosis report card and experimental verification of the effectiveness of feedback information

Study III

Feed back the diagnostic information and check the square library and effectiveness

Quality analysis and statistical analysis of diagnostic results of model applicability test

Study IV

Feed back the diagnostic information and check the square library and effectiveness

Quality analysis and statistical analysis of diagnostic results of model applicability test

Figure 7: Cognitive model of reading ability in junior middle school.

process carried out by students in the process of reading. Therefore, it is difficult to understand the subtle differences in the knowledge structure of different individuals. Therefore, compared with the diagnostic evaluation carried out in this study, this evaluation method is more difficult to play a targeted role in promoting students' learning and improving teachers' teaching methods. Because cognitive diagnosis evaluation can provide students with detailed information about the process and results, micro- and macrolevels at the same time, strengthening the cognitive diagnosis research of subject learning is an inevitable requirement to promote students’ development. Cognitive analysis and expert evaluation are used to analyze the cognitive attributes of reading and solving multiple-choice questions in TOFEL test. Combined with the research results of cognitive processing model of Chinese reading comprehension and influencing variables of item difficulty, the cognitive attributes are identified as follows Table 4.

The basic process of the research is the construction of a cognitive model-the preparation of cognitive diagnostic tests according to the cognitive model and the preparation of supporting facilities at the same time-the preparation of prepared cognitive diagnostic tests and the collection of data-the selection of appropriate CDM for data analysis to obtain cognitive diagnostic results, and the test of diagnostic reliability and validity at the same time-the cause analysis of attribute mastery state-the writing of diagnostic result report-the reverse analysis of diagnostic results check the feedback effect. The details are shown in Figure 7.

Since reading ability is the basic quality of individual ability, the evaluation of reading ability has attracted much
attention at home and abroad. The common feature of the previous evaluation methods of reading ability is to evaluate the subjects’ comprehensive ability, This evaluation idea of paying attention to macroability and ignoring microability evaluation is effective to realize the purpose of promotion seems powerless, and the cognitive diagnosis evaluation theory can not only provide students with detailed knowledge structure but also provide macroreading ability evaluation, which opens up a new way for the improvement of reading ability evaluation methods. In the school scientific language education, the basic task of students’ reading is to teach students how to standardize reading, and through scientific reading, we can understand the information or images conveyed by the author in the text; enrich and develop students’ cognition and emotion; enrich students’ speech forms in terms of vocabulary, sentence patterns, and expression methods; train students’ speech intelligence skills; and then improve students’ reading ability, especially their thinking ability. Because of this, we must strengthen the scientization and standardization of reading. That is, emphasize the standardization of Chinese reading activities.

3. Analysis of Experimental Results

In order to check the rationality and effectiveness of this method, while referring to a large number of previous materials, the number of topics is determined through in-depth discussion with Chinese teachers. The 5-level scoring system is adopted: 5—fully compliant, 4—basically compliant, 3—uncertain, 2—basically noncompliant, and 1—completely noncompliant. Ten students were randomly selected as subjects, and the preliminary effective scores were obtained, which verified the rationality and effectiveness of the, and made full preparations for the next large-scale measurement.

The reliability test in Table 5 uses Cronbach homogeneity reliability and split half reliability to illustrate the consistency of test content or the consistency of all questions in the test through homogeneity reliability and split half reliability; According to Cronbach’s reliability coefficient requirements, the reliability coefficient of the total scale is better than 8.0, and the reliability coefficient of the subscale is better than 0.7. It can be seen from the above table that the reliability of this test fully meets the requirements of Cronbach measurement. In order to avoid the subjective intervention of the researchers, the transcription of the recorded data of the reading report was undertaken by three psychology graduate students. The sound thinking recordings of 30 subjects were transcribed word by word into text files. In order to ensure the quality of transcription, the students checked the recorded data and obtained 30 transcribed text files with a total number of more than 50000 words. The reading time of the report is between 19 minutes and 44 minutes. The detailed reading time of the report and the number of words of the transcribed text document are shown in Table 6.

The metacognitive strategy scale mainly investigates the regulations means for students to reasonably coordinate, arrange, and adjust their learning behavior in the whole process of learning. It includes three dimensions: reading planning strategy refers to the strategy that students timely adjust and take remedial measures according to the survey and statistics, the comparative test results of junior middle school students’ reading comprehension cognitive ability are shown in Figure 8.

There are six cognitive attributes investigated in the cognitive diagnostic test of junior middle school students’ reading comprehension. These six attributes are divided into basic...
reading ability and deep reading comprehension ability according to their difficulty in the level of reading ability. Through the establishment of two-level regression model, the explanation of cognitive attributes to project difficulty is investigated. The hierarchical regression results are shown in Table 7.

Table 8 shows that all the regression coefficients in the model are positive and reach the significance level, indicating that these cognitive attributes play a very important role in the interpretation of the difficulty of the topic. Learning evaluation based on learning behavior pays attention to learners’ mental input and arouses learners’ awareness of self-reflection through evaluation. In this process, learning behavior is the external reflection of learners’ psychological state. The analysis and in-depth interpretation of learning behavior data help to understand learners’ engagement state and provide useful clues for individual learning reflection. This proves that the learning evaluation aiming at Dijkstra algorithm learning is a concept which is aimed at integrating the concept of technology and developmental evaluation and build an ideal learning model of “evaluation promotes learning.”

4. Conclusion

Reading ability is not only the most basic ability for individuals to adapt to future life but also related to national development and social progress. Countries and organizations all over the world attach great importance to the monitoring and evaluation of students’ reading ability. China also started the pilot monitoring of junior middle school students’ Chinese reading ability in the stage of basic education in 2021. In order to better promote the improvement of junior middle school students’ reading ability, it is necessary to conduct a process evaluation of junior middle school students’ reading ability and timely understand students’ strengths and weaknesses in reading comprehension ability, so as to provide timely and targeted
help for students. Different from the general ability score provided by the traditional test, cognitive diagnostic evaluation can detect the internal psychological processing process, skills, and strategies hidden behind the score, so as to diagnose individual cognitive strengths and weaknesses, and help people better understand the internal psychological activity law and processing mechanism of learners’ learning activities. Thus, it will help students themselves, teachers, education managers, and parents to have a comprehensive understanding of students’ knowledge and skills and then help to take targeted remedial measures.

**Data Availability**

The data used to support the findings of this study are included within the article.

**Conflicts of Interest**

The author declares no conflicts of interest.

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