Research on the Expert System of Mathematics Application Question Teaching

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Abstract

In view of the automatic solution process of the elementary school mathematics application question, this article has carried on the research to the mathematics application question teaching expert system. Firstly, this paper introduces the definition and structure of the expert system. Then the system structure and function module of the mathematics application question teaching expert system design, gives a detailed description and design of information extraction module, application of rule base, application type library and application question solving process. In this paper, the application of the problem is divided into an integer one step calculation problem, the integer two steps to calculate the application and fractional scores of three parts of the application. At the same time, according to different types of applications, the structural characteristics of the analysis. According to the information extraction model and mathematical operation rules, the overall framework and function modules of the design mathematics teaching expert system are designed. And the realization process is studied. The research results show that the system can be used to demonstrate the solution of mathematical problems in detail. Help students to understand the application of the problem solving process. Make it better learn to know how to solve the problem. And it is helpful for teachers to easily understand method and carry on the teaching process. This also means that the system has practical application value. As a bridge between mathematical theory and practice, mathematical application problems have become more and more important in the implementation of mathematical quality education. It is necessary to cultivate students' mathematics application consciousness and optimize the students' thinking quality. After leaving school, every student can still think about problems and solve the problem mathematically. In consequence, pay more attention to the teaching of application problems, make the cultivation of the consciousness of "use" of mathematics throughout the whole high school stage, and integrate training students' ability of solving mathematics application question into daily teaching, which is conductive to promote the development of students' mathematical innovation, stimulate mathematics learning interest, and improve internal drive of mathematics learning. In our country, many middle school mathematics teachers have carried on the thorough research on the mathematics application problems teaching, which also has made some progress. However, there are still a lot of mistakes in the application teaching in the daily used system. In particular, the college entrance examination still has its influences, teaching material adjustment is not in place, how to teach the application problems plays a crucial role in the overall implementation of the quality education reform.

Keywords: Mathematics application problem, teaching expert system, information extraction

1. Introduction

Different from the traditional programming, the design of the expert system is based on the knowledge of the program design (Knowledge a basedProgamming). The operation of the expert system needs to be supported by a knowledge base, which is mainly used to solve the special knowledge in a certain field. Such as the GUIDON system of the United States, it can be used to modify and induce the way to answer the medical problems of college students. SCHOLAR system can intelligently answer the question of American geography knowledge. Expert system is used to simulate the decision process which is mainly through knowledge acquisition module from the knowledge base extraction narrative knowledge data. Machine through reasoning and explanation module of data acquisition were internal reasoning, thus completing the human simulation and decision making.

The expert system of mathematics application problems is a kind of expert system [1-2]. Such expert system can effectively assist teachers to solve various problems encountered in teaching activities, but also to help students to better complete the task of learning [3]. Teaching practice shows that the application problems teaching strategy is not rigid or static. The teaching aim is to cultivate students' ability to learn new knowledge of mathematics, proposing, analyzing and solving problems mathematically, as well as the ability of mathematical expression and communication. More importantly, develop students' mathematical application consciousness and innovation consciousness. This study solves the problems of the teachers and the obstacles in the process of students' learning in the application problems teaching, and puts forward a complete set of teaching strategies. The reality shows that the effect is good. And for students in different levels, the levels of model construction in the application problems teaching should also be different.

For the students who are weak in fundamental knowledge, application problems teaching is supposed to transit from the first level of the modeling to the second level, and guide students from the method and awareness, so as to let students happy in mathematics learning and form the confidence in learning mathematics well; for those who are better in fundamental knowledge, the teaching can transit gradually from the first level to the third level. Except for the guidance in method and awareness, it can also allow students to engage in their own practice investigation, and experience the charm of mathematics application. For the students who have excellent knowledge foundation, they can be arranged to make some valuable application problems on the basis of practical investigation. Teachers and other students are supposed to discuss together and open train of thought. This research has carried on the discussion and the practice, carries on the more thorough research on the application question teaching.

Because of the application of the language, the understanding of the language, the relationship between the numbers of judgments, the choice of such factors as the choice of these factors is making it difficult for students to increase the difficulty of solving. At the same time, it also makes the teaching difficulty of the application of the teachers to increase [4-5]. In this paper, according to the teaching design automation theory, information extraction methods and reasoning technology. A teaching expert system prototype is constructed, which can be used to solve the problem in the process of solving the problem. It can improve the ability of solving problems independently. In addition, it is helpful to improve the plight of teachers in the teaching of applied problems, enhance the teaching ability and enrich the teaching experience.

2. Significance of Mathematics Application Question Teaching

New "High School Mathematics Curriculum Standards" (Mar.18, 2002 draft) clearly put forward that mathematics is the science to study the space form and the quantity relation, which is the science researching on mode and order. Mathematics is an important

part of human culture, which constitutes a basic quality that a citizen must have. Mathematics science has always been the basis of natural science and social science, now going to the stage from behind to the front. In some ways, it directly creates value for the society and promotes the development of social productive forces. Increasingly wide range of mathematical applications is constantly infiltrated into all aspects of social life. Mathematics plays a unique and irreplaceable role in the process of forming human rational thinking, and highly developed mathematical thinking has become an important symbol of the progress of human society.

Mathematical sciences have the tradition of realism of "problem solving" like mathematics in ancient China, but also possesses rational spirit of "deductive reasoning" advocated by Greek. The maturity of the modern society has led to the depth and strictness of Hilbert formalism. Therefore, the principle drawn up by the middle school mathematics curriculum standard in new century is as follows.

(1) Enable students to have the necessary mathematical knowledge, basic skills, as well as the mathematical thinking and methods embodied in it, and let them have a more open vision of mathematics.

(2) Improve students' ability in various aspects, such as space imagination, intuitive guess, induction abstraction, symbolic representation, computation, deductive proof, system construction *etc.* And based on this, cultivate students' ability to learn new knowledge of mathematics and the ability to provide scientific solutions for analyzing and solving problem, mathematical expression and communication ability; develop students' mathematics application awareness and innovative consciousness. In addition, it is hoped that it can be able to rise as a kind of mathematical consciousness, consciously think and make a judgment on some of the mathematical model contained in the objective things.

(3) Stimulate students' interest in the learning of mathematics, so as to let the students form confidence in learning mathematics well. Get to know the scientific value and humanistic value of mathematics, advocate the rational spirit of mathematics thinking, appreciate the aesthetic charm of mathematics, and form critical thinking habits, so as to further set up a world outlook of dialectical materialism.

2.1. Excellent Education Function of Mathematics Application Problems

Mathematics education should first consider to meet the needs of all students in live and work in the future, not only to promote the comprehensive development of the student, but also provide adult experience, opportunities, and responsibility for the students. In recent years, application problems in the preparation, attaches great importance to the development of educational function. Most of them take the actual situation of our country and urgent hot point problem as the background. It not only reflects the mathematical society in a certain extent, and becomes a window for the cultivation of students' spirit of patriotism, and enhancement of their sense of social responsibility, and understanding of the social. As a result, let the quality education implemented and lay the foundation for students entering into the society. The application problems are of variety, such as involved in the problem of desertification, soil and water loss and population problems and so on.

2.2 Ability-oriented Education

General secretary Zemin Jiang has pointed out: "We must adhere to the combination of education and social practice, take improving the quality of the people as the fundamental purpose, and regard the cultivation of students' innovative spirit and practical ability as the focus."

Mathematics discipline comes from practice and it is widely used in practice, which plays an important role in improving the quality of the people. Mathematics application question is necessary in the cultivation of students' innovative ability and practical ability. The American Institute of Mathematics Teachers (NCTM) pointed out that the main purpose of learning mathematics is to solve the problem, and it is the process of applying what is learned to new and unfamiliar scenarios. Mathematics application question is the educational process of making use of mathematical knowledge, mathematical methods and mathematical ideas to analyze and research on the phenomena of the objective world and organize it. The mathematical model is set up by the practical problem, forming the mathematical problem, and then solves the problem by using mathematical thinking and mathematical method, which is a kind of ability-oriented education.

The factors that ability involves in are of variety (psychological factors, physiological factors, *etc.*), which is understood by the psychologist as the personalized psychological characteristic that has direct and stable regulating function in the smooth and effective operation of activities. Mathematical ability is a special ability, which is the ability that the general ability resides in this special field in mathematics. The other is in mathematics learning process, according to the strict mathematics logicality and characteristics of highly abstract and wide range of application, the mathematical ability structures can be attributed to "five ability elements - mathematics observation ability, mathematical memory ability, mathematics thinking ability, space imagination ability, and mathematical ability."

2.3. Openness of Mathematics Teaching

Mathematics application question teaching is certainly not a simple process of "knowledge + case", but a kind of open teaching process. By guiding the students to investigate real life and production, and many objects in the nature, showing colorful mathematics application examples, naturally integrate application in daily teaching. Students in knowledge acquisition, at the same time, actively learn the methods for self-knowledge of mathematics, learn the ability of actively participating in mathematical practice, and acquire lifelong mathematical ability, so as to further gain development opportunities. The teaching process of mathematics application problems is the process of students' construction and active participation. The topic itself is open in condition and open in conclusion, which is conducive to cultivate the students' consciousness of mathematics, truly learn "mathematical thinking", and thus cultivate students' exploring, pioneering spirit and creative ability.

2.4 The Best Carrier of Teaching

To solve the problem of mathematical application requires to possess with two levels of abilities. One is the ability of mathematics. That is to say, the ability of transferring the practical problems into the mathematical problem, which involves in mathematical reading ability and the ability to solve mathematical problems. Mathematics is the pilot for all the mathematics applied in the reality. Without mathematical material, it is difficult to use mathematical methods to deal with a practical or realistic problem [4]. Only after mathematics, it is possible to solve the problems by making use of mathematical ability is the focus of teaching, which is the core of the ability to solve practical problems together with mathematical thinking. Mathematics educator Freudenthal once said: "it is not so much to let the students learn mathematics, it is better to say to let the students learn the "mathematization". The role of mathematical application question in this process cannot be replaced.

3. Research Contents

3.1. An Overview of Teaching Expert System

Expert system is one of the most important and active application areas in artificial intelligence. It realizes the artificial intelligence from the theoretical research to the practical application, from the general reasoning strategy to explore the use of specialized knowledge of a major breakthrough.

In 1965, Stanford University, E.A. Feigenbaum, and a chemist, J. Lederberg, developed the world's first expert system. In 1977, E.A. Feigenbaum, a computer scientist at the Stanford University, proposed a new concept of knowledge engineering at the Fifth International Conference on artificial intelligence. Since the 1980s, under the promotion of knowledge engineering, the emergence of a lot of expert system and development tools, such as EMYCIN, CLIPS (OPS5, OPS83), G2, KEE, OKPS and so on.

The research of expert system in education teaching is helpful to teachers' teaching and students' learning. At present, the research of the expert system in the field of teaching in China is still in the exploratory stage, but some achievements have been obtained. In 1998, Zheng Yongbai put forward the theory of teaching prescription in his doctoral thesis "teaching system design theory and method research -- Teaching Prescription Theory and design and development" [5-6]. InterModeller is a computer program that is used to support the learning concept of primary and middle school students and the skills related to classification. The program has the knowledge base, inference engine and rule base. Ma Ning's knowledge base of teaching mode in teaching design is discussed, in which the idea of teaching design automation is used to study the process of mathematical problem solving process [7].

And for different areas of the designer, the definition of its description is not the same. Known as "the father of expert systems and knowledge engineering", Stanford University professor Feigenbaum Edward, the definition of expert system is: a smart computer program, the use of knowledge and reasoning to solve the problem of the system. That is to say, the expert system is a kind of computing system which can simulate the decisionmaking ability. The basic structure of the expert system is shown in Figure 1.



Figure 1.The Structure of Expert System

Knowledge base: a knowledge base that contains the knowledge and solutions to solve the problem. It is a specific knowledge warehouse of various experts and scholars. It is reflected in the rules of knowledge, framework, logic, semantics, *etc*. The knowledge base of expert system contains factual knowledge and exploratory knowledge.

Reasoning machine is an equivalent of a human's brain with a strict reasoning mechanism. It usually controls the rules of the structure and provides reasoning methods. According to the knowledge of the knowledge base, according to certain reasoning

strategy, solving the problem, explaining the facts and data of the external input, the conclusion is derived and the user tips, *etc*.

Knowledge acquisition: the module is an auxiliary function of the expert system, it will internal representation of knowledge conversion, processing of microcomputer. For the original knowledge in the knowledge base and modify the expansion of new knowledge, it provides appropriate means, maintain the knowledge consistency and integrity. And responsible for the good performance of the knowledge base is established.

3.2. The General Design of the Expert System of Mathematics Teaching

According to the analysis of the problem solving process of the elementary school mathematics application, combining with the basic structure of the expert system, divided the system into the following modules, as shown in Figure 2.



Figure 2. Function Module of the Expert System for the Application of Mathematics in Primary Schools

3.2.1. System Management

Users can query, modify, add, delete and other functions of the contents of the knowledge base through the management authority.

3.2.2. Knowledge Based Management

In this system, the knowledge base management includes the management of applying the rule base of the application and the management of the type of problem. In the management of the rule base, it can be divided into manual management and automatic management. User is use of the manual management to solve the problem of information. Artificial judgment, extracted from the operator can be used to determine the rules of information, and will be stored in the rule base. The manual management rules can be improved, the success rate of operator. Automatic management system is based on the user input of the application of information, information extraction. And the extraction of a variety of lexical information is stored in the semantic dictionary [8]. At the same time, the system will extract lexical information from the existing rules in the rule base to judge the existing rules. Due to the application of semantic information extraction, there is a certain error. For operators to determine, there is a large error, low efficiency. Therefore, the need for manual intervention can be resolved. Application item type library is a framework for storing various kinds of problems. In this framework, there are different types of application problems. Users can add, delete, modify and other operations based on the classification of the application questions.

3.2.3. Knowledge Acquisition

Knowledge acquisition includes semantic information extraction and application. To extract information from the application questions which were established data repository, quantifier relation database and keywords, offers the effective information that will be applied to store separately the three libraries. The problem classification is mainly based on the artificial way to store different types of applications in the framework of the application of knowledge classification.

3.2.4 Application of Problem Solving

This part is based on the content of the knowledge base and the application of the calculation based on the rules. In the process of solving the problem, we first need to use the information extraction of the problem, and then according to the extraction of information to determine the application of the solution operator. In this process information extraction is the key, the operator is the main.

3.3. Design of Main Modules of the System

3.3.1. Design of Information Extraction Module

Based on the rules of information extraction, this section discusses the extraction model of mathematical application problems. In information extraction rules, contains five elements: path extraction (extract path), the extraction of pointer (extract point), left and right neighbor (prevailing. The next sibling identification, fixed text (fixed text, text feature (text feature).

The extraction path is to select the text information in the text, and determine the path to be extracted according to the node sequence.

The extract point is a pointer to the first character.

The left and right neighbor mark is a node in the left and right sides when extracting the current information.

Fixed text refers to the main content of the extraction of information or fixed text form. Text feature refers to the properties of the text.

The expression of information extraction rules is as follows:

"Semantic item" =Step (node path, extractpoint, prevsibling, nextsibling): Predicate [fixedtext, textfeature]

According to the extraction rules it is for the application of the information representation, the process as shown in Figure 3.



Figure 3. Information Extraction Process

Due to the application of the title contains a lot of information, such as problem solving keywords, measure words, numbers and unrelated words. It is necessary to extract the application information are stored in key thesaurus, quantifier relation database and data library. For the unrelated words is rounding.

3.3.2. Design of the Application of the Rule Base

In the process of mathematical problem solving process need to judge the operator, according to the representation of knowledge in generative knowledge representation (IF..... THEN, the string matching conditions of the judgment operator is converted to IF..... THEN statement design.

When an application of information input, by the HowNet technology application on the topic were formal expression matching the extracted string information and rules library policy code information, if a successful match selects the corresponding operator, if the match is not successful, it returns, again to the original application of information extraction until a successful match so far. When a rule base is added in the rule base, the program can extract information from the user's input according to the information of the user's input, and judge the information to match the rules in the rule base. Operator's judgment is based on string matching, however, how to match, the need to match the rules to carry out. Therefore, the extraction of the semantic information of the applied problem is the precondition to establish the matching rules.

3.3.3. Design of Application Item Type Library

The type of mathematical application problems can be divided into an integer one step computation application problem, the two step calculation application problem, the fractional application problem, the fractional four arithmetic application problems, the proportion application questioned the column equation application problem. Therefore, according to the framework, we can express different types of applications [9]. According to the frame method, the knowledge type of mathematical application problems can be expressed, which can be converted to the type of knowledge base, that is, the design of knowledge base of mathematical application. Then according to the database design principle, can use the method of inserting, deleting and modifying to carry on the concrete operation.

3.3.4 The Design of the Application of the Problem Solving Process

According to the division of the function module and the key technology of the expert system of mathematics application question based on Figure 2, this part gives the detailed process of solving the mathematical problem. As shown in Figure 4:



Figure 4. Mathematical Application Question Solving Process

4. The Realization of the Main Module of Teaching Expert System

The overall structure of the expert system and the design idea of each function module are discussed in the paper. This section combines the above content, from the system function modules to achieve the way, algorithm and parameters of the point of view, a brief discussion of the main modules of the system to achieve the idea [10].

4.1. User Management

In the user management module is mainly to achieve the management of user information and rights management. To achieve the function, it can be divided into two steps: 1) to create a database of users: for the userid field, username, RoleID (authorization ID, int, foreign keys, associated permissions table (0 ordinary users, 1 for administrator] 0 by default). IsLogin (type of bit, 0 said registered users. 1 that is not registered, the default value is 0) *etc.* It also need to build a permission table role, the field RoleID (authorization id int primary key, since the increase), and the role name (permissions. For ordinary users and administrators); 2) of the background to add users, the insert operation, users add to default ordinary users. If you want to change the general user to the administrator, only the UpdataUser table in the RoleID=1 can be implemented in the program distribution rights.

4.2. Knowledge Based Management Module

In the management of knowledge base, the database is divided into the application of the rule base and the type of application. Therefore, need to build two data tables, named as RuleDB (the application of the rule library) and TypeDB (the type of Title Library).

1) Implementation of rule base

Step 1: create a user RuleDB database. Set the field for the UserName, RuleID, (ID, int primary key, since the increase; Name, string)

The second step: the user in the rule base page through the insert operation will be added to the rules of a rule library. In addition, users can also delete, modify the contents of the rule base to operate.

4.3. Implementation of the Type Library

In the module of the application question type, the design of the tree is adopted. Users can add a child or delete, modify the way the sub item on the type of application of the interface to operate. In net preview can be used to create the ASP. Control tree structure. The main types and sub types can be added by the following algorithm.

```
1) Add main type algorithm
int nummain=ds. tables [0]. rows. count;
for (int i=O; i<nummain; i++)
{treenode node=new treenode ();
node.text=ds. tables [0]. row[i][1]. costing ();
tree.nodes.add(node):
node. expanded=true;
int main ID=convert.toint32(ds2.tables[0], rows[i][0].tostring ());}
  2) Add sub type algorithm
public void addsubtrue (int mainID, treenode Anode)
      {sqlconnection con=new sqlconnection ();
      con. open ();
      sqldataaddapter adpl=new sqldataapter
("select*from subbords where mainID="mainID+"", con);
      dataset ds 1=new dataset();
      adpl. fill(dsl)
      Int numsub=dsl. tables [0]. row. count;
  for (int i=O; i} numsub; i++)
       {treenode node=new treenode ():
      node.text=ds l. tables [0]. row[i] [2]. tostring ();
```

pnode.nodes.add(node);}}

5. Conclusion

Mathematics application question teaching expert system can extract information useful in mathematical problem, and specific operational value assignment to focus on the knowledge of operation variables in operation. At the same time, the system using Common KADS model based on rule reasoning function. According to the method of generative knowledge representation, the reasoning rules to judge the data word quantity information of mathematical application problems. The system can show detailed mathematical problem solving ideas, helpful for students to understand the application question solving process, make the better the learned learn to use the problem solving process; and in favor of the teachers in the application problems in the teaching process, the use of simple method of teaching [11]. Therefore, the system has practical application value. In the actual teaching practice, we have realized that the key of improve the teaching level is the change of teacher's teaching idea. Pay attention to the teaching of application question, let the cultivation of students' "use" mathematics consciousness throughout the high school stage, and integrate training students' ability of solving mathematics application question into daily teaching, which helps to promote the development of students' mathematical innovation, stimulate mathematics study interest, and improve internal drive of mathematics learning. This study further analyzes students' learning psychology, and does researches on teachers' application ability, and further deepens and summarizes the teaching principle that should be noticed in application question teaching.

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