Construction of Practical Teaching System of Database Principles based on Core Literacy

Hua JIN*

Abstract

The promulgation of the overall framework of Chinese students' development of core literacy has made the implementation of core literacy into specific teaching activities an urgent problem to be solved in the field of education. Based on the analysis of the problems existing in the undergraduate education under the mode of emphasizing theory and neglecting practice, this paper constructs the practical teaching system of Database Principle Course Based on the core quality, expounds the implementation strategy of practical teaching, and probes into how to train the students in the practical teaching of database principle Cultivate scientific spirit, learning ability, practical innovation, responsibility and other core literacy. After 5 rounds of practice, students have achieved better development in independent development and collaborative work, and their awareness of practical innovation has been significantly improved.

Keywords : Core Literacy, Database Principle, Practical Teaching System

1. Introduction

Nowadays, under the background of highly information age, the business of all walks of life is increasingly inseparable from database technology. Database principle is the core course and compulsory course of computer major and related majors [Ministry of Education College Computer Science and Technology Teaching Steering Committee, 2009; Bailis and Balakrishnan, 2019; Li and Guo, 2016]. As a professional course with strong theory and practice, database knowledge is the basis for students to design information system and develop software in their work [Xiong, 2016; Kong, 2019]. However, for the graduates of computer major who are trained under the mode of thinking of theory and practice oriented undergraduate education, employers generally reflect that there is a certain gap between their practical ability and practical ability and the demand of the employment market [Li and Li, 2016; Chen, 2018]. Therefore, it is urgent to cultivate and cultivate talents with practical and innovative ability [Cao et al., 2015].

Based on the analysis of the existing problems of the undergraduate education under the mode of emphasizing theory and neglecting practice, Taking the course of database principles as an example, this paper constructs the practical teaching system based on the core literacy and expounds the implementation strategies. In the process of constructing the practical teaching system of database principles, this paper takes into account the fact that there is a large gap in learning ability between students in local ethnic colleges and universities, and discusses how to integrate the core literacy into the practical teaching, that is, the cultivation of scientific spirit, learning ability, practical innovation and responsibility in the six core literacy in the practical teaching, so as to make the practical teaching system of Database Principles Change of value orientation to promote the improvement and all-round development of students' ability [Zhu et al., 2017].

2. Problems in Practical Teaching of Database Principles

After the organization for economic cooperation and development (OECD) launched the definition of core literacy in the 1990s, many countries have joined the research queue of core literacy. In September 2016, China officially released the overall framework of core literacy for Chinese students' development, and scholars at home and abroad unanimously emphasized that core literacy is a necessary character and key ability for a person to adapt to life-long development and social development [Zhu et al., 2017; Zhong, 2016]. Having core literacy can adapt to the changing and complex social development. The cultivation of core literacy has become the core goal of the current curriculum reform in China.

The principle of database is a core compulsory course of both theory and practice. It not only requires students to master the basic theoretical knowledge of database, but also requires students to be able to design database and application programs according to actual needs. It is one of the training objectives of computer science and technology professional certification standards to make students' learning transition from simple, confirmatory experimental projects to the design and implementation of a complete information system based on software engi-

neering, with a high contribution to the training of professional and technical personnel in the field of information system planning, construction and operation.

The practical teaching of the course of database principle is divided into three parts: experiment in class, project practice and graduation project. In many universities, the traditional teaching activities of database principles, under the influence of the cultivation thinking of the undergraduate education of emphasizing theory and neglecting practice, lack of attention to the practical teaching link. The main problems are as follows. First, there are few hours in practice class. The experimental class hours are only 1/3 of the theoretical class hours, and the database project practice is only 32 class hours. Therefore, the teaching activities are mainly "knowledge transfer", ignoring the development of ability. Second, the experiment is simple and unattractive. The main content of the experiment is confirmatory experiment, which lacks the coherence between knowledge points. It only pays attention to the development of scientific spirit, but neglects the cultivation of independent learning ability and innovative practice ability. Third, lack of team spirit. Due to the limitation of class hours, it is impossible to arrange the group defense, and only pay attention to the evaluation of the results in the evaluation criteria, which does not reflect the cooperation between the group members and the contribution of individuals in the group, and the sense of responsibility is weak. In a word, there is a certain gap between the cultivation of core literacy in practical teaching and the requirements of sustainable development that enterprises really need to have a sense of responsibility and the ability to solve problems independently.

3. The Construction of Curriculum Practice Teaching System based on Core Literacy

The practice teaching system of database principle course is constructed in the order of "in class experiment project → project practice → graduation design". It is a training process from verification experiment to design and comprehensive experiment, from cooperation to independent task. In the process of constructing the practical teaching system, we should focus on the cultivation of scientific spirit, learning ability, practical innovation and responsibility taking literacy among the six core literacy, and at different stages, we should cultivate different core literacy, and scientific spirit is the most core literacy to be cultivated in this course.

3.1 In Class Experiment Items

3.1.1 Design of Experimental Project

According to the requirements of the practical teaching system and standard for computer science and technology majors in Colleges and universities [Ministry of Education College Computer Science and Technology Teaching Steering Committee, 2008] (hereinafter referred to as the practical teaching system and standard), combined with the actual situation of the school where the author is located, there are 10 experimental items in the course of database principle, that is, to understand a relational database management system, to establish a database, to operate the database, integrity constraints, security control, to use views and indexes, to use triggers, to use stored procedures, database programming, query optimization. Among them, the first six are the basic experiments are required, the last four are comprehensive

experiments, and two are optional. embedded SQL programming and query optimization is a new comprehensive experiment, which is conducive to training students' learning ability and innovation practice ability. The practical teaching system and specification requires that students should be familiar with the syntax and functions of SQL language, and be able to write database applications in combination with advanced language. Therefore, only SQL language is allowed to be used in the practice process, and the graphical interface operation mode is only used to view some experimental results.

3.1.2 Design of Experiment Process

In order to increase the coherence of the corresponding knowledge points in the experiment, roles are used throughout the whole experiment process. There are three roles: students, teachers and administrators. If a student chooses a teacher user, all of his experiments are determined by the needs of the teacher user to ensure the continuity between experiments. In the experiment content, add items that are conducive to the cultivation of logical thinking ability, such as logging in the system as the user in the security control to verify the authority, analyzing the role of multiple triggers in a table in the trigger experiment, etc. The purpose of adding "backup and restore database" in Experiment 1 is to let students learn the technology of backing up database as early as possible. Each experiment only needs to restore the database backed up last time, instead of reestablishing the database (because the hard disk of the laboratory is protected).

The experiment content is designed according to the following principles. 1) The principle of giving consideration to both foun-

dation and improvement. The author's University is a local university for nationalities, with obvious differences in students' levels. Some minority students are poor in understanding and learning ability. Therefore, in the design of experimental projects, there are more basic projects, while for students with higher learning ability, there are some more difficult experimental projects designed separately. 2) Develop the principle of using modern tools to acquire new knowledge. In the experimental class, when students write and execute the command according to the standard grammar of the textbook, the system will prompt grammatical errors, which is caused by the difference between the actual system grammar and the standard grammar. Teachers guide students how to use online books to get correct grammar, and find solutions to problems, teach students to master the principles and grammar structure, rather than rote grammar, and gradually cultivate students' independent learning ability.

3.1.3 Evaluation Method

The traditional evaluation method is based on whether the results are correct or not, while the evaluation mechanism based on core literacy pays more attention to the evaluation of innovation practice and learning ability. The main factors considered in the scoring standard include the completion of basic functions, the correctness of methods or sentences, the novelty of ideas, the innovation of methods, etc. students are encouraged to adopt multiple methods to achieve this, and even if the completion of the report is not high, students are encouraged to actively cultivate the core quality of practical innovation, guide students to actively improve their knowledge system .

3.2 Database Project Practice

"Database project practice" is a follow-up independent course of "Database Principle", mainly to cultivate the design ability of database. In the case of concentrated class in short term, the students do not have enough time to design and implement database management program, nor time to arrange defense, so the teaching effect is not ideal, especially for the students with learning ability below the middle level. Therefore, the author's major changed the practice of database project to normal term arrangement, with an average of 3 class hours per week. Students can make reasonable use of their time in and out of class, have enough time to think and analyze problems, complete design tasks with high quality, and complete the defense in class. This teaching method has been carried out five times, the design quality of students has been improved significantly, and the sense of self-efficacy has been improved significantly.

3.2.1 General Design Requirements

There are 48 class hours for database project practice, and 4-5 people cooperate to complete the design and implementation of a simple database management system. In order to fully mobilize the enthusiasm and coordination of students, it is necessary to combine the members of the group freely. The questions can be selected from the ones given by the teacher or prepared by the students themselves, but they need to be checked and determined by the teacher. After the completion of the design, the students are required to submit the database, application program, project practice report and other results, and add the defense link, and the group as a unit

to all students for defense. Finally, according to the usual performance, report quality and defense situation comprehensive evaluation results.

3.2.2 Design of Practice Process

The process of project practice is an important part of cultivating core literacy. Students are encouraged to participate in the design of each step with the attitude of inquiry, analyze problems with scientific thinking methods, and actively explore solutions to problems. At the same time, the team members are required to maintain close contact and full communication, promote and develop each other, and complete the task reasonably. The whole project practice design schedule is shown in ⟨Table 1⟩. The time allocation in each stage is relative to the 48 hour arrangement. The report in the evaluation refers to the beginning and ending time of the student's report writing, and the starting time of the reply can be adjusted before and after the actual number of students. In the design process, set up the check and confirmation point of mile stone [Chen, 2018], which will be implemented in three times. The first time is after the completion of conceptual structure design, the second time is the defense, and the third time is the quality inspection of the report, providing the basis for the evaluation mechanism.

The design of each schedule in ⟨Table 1⟩ mainly considers the design of database structure and the principle of application program implementation. The specific implementation can be adjusted according to the situation of students and class hours, while the checkpoint should be set according to the evaluation standard.

〈Table 1〉 Project Practice Schedule

Main work	Design content	Time allocation (48 class hours in total)
Preparation	Topic selection and grouping	
Database design	Requirement analysis Conceptual structural design Logical structure design Physical structure design Set up a database	
Application design	Development environment Functional design Programming Test	
Evaluate	Report Defence Checkpoint	★　　　　★　　　　★

3.2.3 Evaluation Method

The basis of curriculum evaluation comes from three aspects, one is the report of conceptual structure design, the other is the defense situation, and the third is the final report. According to the syllabus and on the premise of paying more attention to the evaluation of team cooperation ability, a table of project practice course results is set up, as shown in 〈Table 2〉, which is mainly composed of the evaluation of team cooperation ability and individual ability. The report of conceptual structure design only accounts for 10% of the total score, because it is only a phased achievement, which can be modified under the guidance of teachers in the later stage. The results of the oral defense are divided into functional completion, group oral defense and individual oral defense. The first two items are the evaluation of team coope-ration, and group oral defense is the average of individual oral defense of all group members. Team members should cooperate to complete PPT and work demonstration for defense and participate in defense. Teachers ask questions according to each person's division of labor, and finally evaluate personal performance according to the answers and the difficulty. The purpose of the answers is to distinguish the evaluation of each member in the group. The report is mainly evaluated according to the correctness of each stage of database design, the writing quality of the report and the organizational structure of the article. The score and proportion of each score in 〈Table 2〉 can be adjusted according to the overall situation of the class and the progress of project practice, but the evaluation of team cooperation ability cannot be lower than 65 points, and the proportion of defense score cannot be lower than 60%.

〈Table 2〉 Composition of Project Practice Course Scores

Content	conceptual structure Design	Defence score			Report quality	Total
		Function completion	Results of group defence	Personal defence score		
Score	100	50	20	30	100	
Proportion of total achievements	10%	60%			30%	100

3.3 Graduation Project

After the training of in class experiment and project practice, the students have the ability to comprehensively use all kinds of theoretical knowledge and technology learned in the undergraduate stage and solve practical problems independently. The author's school adopts two-way selection, that is, the way of teachers' questions, students' topics and teachers're selection of students. Each topic can only be selected by one student, and students should complete the design task independently. The graduation design (Thesis) questions from 2015 to 2019 are shown in 〈Figure 1〉. The proportion of 1 in the figure indicates the proportion of database related topics to design topics, and the proportion of 2 indicates the proportion of database related topics to total graduation design (Thesis). Each year, the design topics account for 63% of the total graduation design (Thesis) topics on average, while the database related topics account for about half of the design topics, with an average value of 47%. In the past five years, the database related topics account for 29% of the total graduation design (thesis) topics on average.

The graduation project related to database is easier to find in real life, and it is easier for students to do demand analysis and understand the processing flow of various data. By completing the graduation project related to database, students can improve their ability in the following aspects: 1) communication ability. It is necessary to fully communicate with decision makers, managers and users in relevant fields to do a good job in demand analysis; 2) analysis ability. According to the needs of different users, comprehensive use of knowledge to analyze and find solutions, algorithms and technologies; 3) independent programming capabilities. Most of the in class experiments are mainly confirmatory experiments, with a small number of design and comprehensive experiments. The project practice course needs to complete a complete database management program, but it is completed by 4~5 team cooperation. The graduation project is the information management system which can be completed independently. It is an important link that can comprehensively evaluate whether a student has certain scientific literacy, ability to analyze problems, ability to comprehensively use knowledge and ability to apply documents.
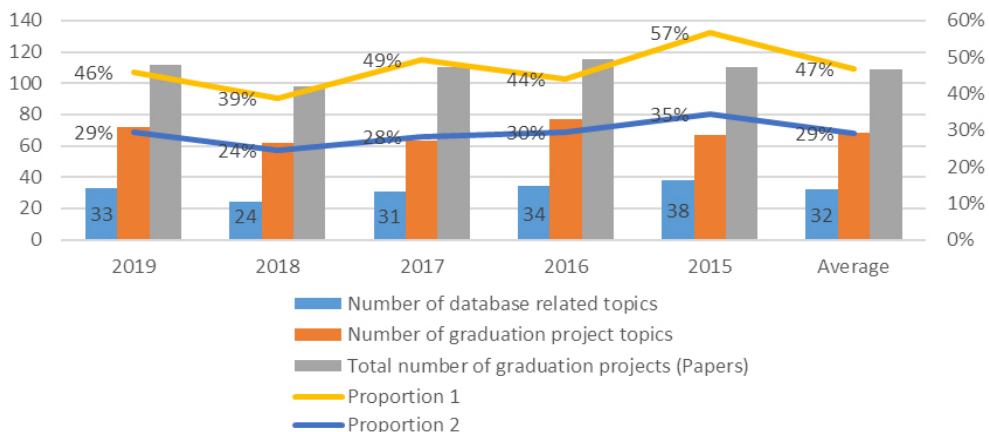
〈Figure 1〉 Graduation Project (Thesis) Question Drawing

4. The Implementation Strategy of Database Principle Practice Teaching

4.1 Role Determination Experiment Content

If the experimental project is designed only to verify theoretical knowledge or specific grammar, the experimental process is just a process, which can not arouse students' interest and enthusiasm. The author has solved this problem by using the situational experiment mode. First, before the experiment, let students choose their favorite roles, such as students, teachers, administrators. Then students put forward users' needs according to their roles, that is, as students or teachers or administrator users, "what am I going to do?" What information do I want from the database. Then the teacher chooses the reasonable and typical topic as the experimental content, that is, to determine the experimental content of the student user, the teacher user and the administrator user respectively, and the students complete the corresponding experiment according to their chosen role. And for the adopted topic, give extra points to encourage. The advantage of setting experimental content according to role is that the experimental content itself is a problem that students care about, which is conducive to arousing students' interest and enthusiasm, and helping to cultivate students' scientific spirit, learning ability, practical innovation ability and other core qualities.

4.2 Improve Learning Ability

The course teaching pays too much attention to the explanation of theoretical knowledge and ignores the cultivation of professional skills and learning ability (Li et al., 2018), the result will be that students only deal with the examination, fail to strengthen the course knowledge system through practice, the foundation is not solid, and there is little left for the course content after the examination. There is a famous Western saying: "what you have heard will be forgotten, what you have seen will be remembered, and what you have done will be understood". If you don't write code for in class experimental projects such as database operation, security and integrity control, view, trigger, query optimization, you won't be able to understand the syntax structure, let alone the connotation of the basic principles of related databases. Many methods are used to cultivate students' scientific spirit and learning ability, such as: introducing role model to improve students' interest and enthusiasm when setting up experimental projects; implementing authority verification and database state change analysis in security control experiment to improve the understanding of authorization mechanism; in query optimization experiment, through a variety of different conditions, comparative analysis of the impact of query efficiency What are the factors of rate, the relationship and difference between triggers and stored procedures, etc. In this way, design reasonable and diverse experimental projects and methods, stimulate students to think and operate more, deepen understanding of theoretical knowledge through practice, and build their own knowledge system.

4.3 Develop Team Work Ability

Under the background of artificial intelligence and big data, teamwork spirit and communication ability are especially valued in the IT industry. Therefore, the practical teaching of database principles needs to cultivate students' teamwork ability and responsibility

accomplishment. 1) Encourage students to discuss. Different students have some differences in the understanding of the content of the class, some of them have strong understanding ability and some of them are lack. Through discussion, we can narrow the gap, and sometimes students are more willing to accept the explanation of "student teacher". 2) Mobilize enthusiasm. Give full play to everyone's strengths, cooperate to complete system functions, reports, PPT and defense materials, etc. Some students are not allowed to only do document processing, but ignore the improvement of professional course ability. Therefore, in the evaluation, 50% of the team members completed the results together, 30% of the individual defense results, and 20% of the group defense results. The group defense results are the average of the individual defense results of all members, that is, the performance of each member directly affects the performance of other members of the group. In order not to pull back, all members should actively cooperate with the work arrangement of the team leader and complete the task conscientiously. 3) Pay attention to the responsibility of student leaders. As the project leader, the team leader should reasonably assign tasks and supervise the progress of the project, which is helpful to cultivate students' leadership. After several semesters of practice, in the design of database, the realization of system functions and the link of defense, the participation and contribution of each member has been significantly improved, and there are basically no poor students.

5. The Cultivation of Core Accomplishment in the Practice Teaching of Database Principle

The six core qualities that Chinese students should possess are humanistic background, scientific spirit, learning ability, healthy life, responsibility and practical innovation, which are the ultimate goal of school education. The core literacy needs to be realized in the teaching link of each course, and each course has certain contribution to the cultivation of students' core literacy. Core literacy is not only a curriculum goal, but also a new curriculum concept [Zhang, 2016]. How to carry out the core literacy in the construction of each course is an important task for each syllabus writer and front-line teachers.

The training objectives defined in the training program of the author's major are mainly divided into the following five aspects: 1) communication and cooperation ability, 2) basic theory and technology required by the major, 3) application ability and innovation ability of professional technology, 4) independent engineering practice ability, 5) lifelong learning ability. Under the guidance of such professional training objectives, the construction of the practical teaching system of database principles is designed mainly for the cultivation of scientific spirit, learning ability, responsibility, practical innovation and other core literacy.

5.1 The Cultivation of Scientific Spirit in Practical Teaching

The core quality of scientific spirit mainly includes logical thinking, critical questioning and courage to explore. It is the most important core quality to be cultivated through the practical teaching of database. According to the training plan and syllabus of my major, the course objectives of database theory and practice teaching meet 8 of the 12 graduation requirements, which highly supports the graduation requirements of the major.

Taking the query optimization experiment as an example, the purpose of the experiment is to understand the query optimization mechanism in the actual system and the factors that affect the query optimization scheme. First, let students design experiment conditions and verification content according to heuristic rules. Prepare a data table with enough tuples, and then adjust the data in the database according to the experimental conditions, that is, prepare more or less records that meet the conditions, index and no index on the attributes in the conditions, prepare multiple different equivalency expressions (with different operators) for the same query requirements, etc. After the preparatory work is completed, the query optimization plan provided by SQL server is used to observe the optimization scheme of the system, and then the query optimization mechanism of the actual system is determined through analysis. In the whole experiment process, the teacher only provides the experiment plan and data, and the specific experiment process is designed and implemented by the students themselves, which guides the students to use the knowledge they have learned to explore and solve the problem and improve their rational thinking ability.

5.2 The Cultivation of Learning Ability in Practical Teaching

According to the survey, the most concerned quality of enterprises is the development potential represented by learning ability. The learning ability required by the professional certification standard of Engineering Education in China also includes the ability to solve complex engineering problems, access to information, information ability and lifelong learning ability [Ministry of Education College Computer Science and Technology Teaching Steering Committee, 2008].

The cultivation of information acquisition ability and lifelong learning ability is mainly reflected in the learning process of SQL grammar in the in class experiment. In the experiment class, students are guided to find the correct grammar through online help or the Internet, so that students can master the grammar structure, not the grammar itself. Students can still use this method to learn new knowledge after the follow-up courses and work, and constantly broaden their knowledge. The ability to solve complex engineering problems is developed through the whole practical teaching process, such as: in class experiment, role method is used to make students actively find problems; project practice, team cooperation method is used to analyze and solve practical problems; and graduation design process focuses on the ability to independently undertake small-scale engineering projects and participate in large and medium-sized projects.

5.3 The Cultivation of Responsibility in Practical Teaching

Enterprises hope that computer graduates have a strong sense of responsibility and the ability to solve problems independently, and they also need to get along with others harmoniously and work together. China's engineering education professional certification standard also requires students to have certain organizational management ability, strong expression ability and social responsibility. In the final analysis, these abilities are the responsibility accomplishment in the core accomplishment.

The ability of responsibility and communication is cultivated in a step-by-step way in

the practical teaching of database principles, that is, the small-scale discussion in the experiment in class, the team cooperation in the project practice and the independent working ability and social responsibility in the graduation design stage. In addition, in the project practice, the responsibility requirements for the team leader are conducive to the cultivation of personal leadership, and everyone is required to make a difference. For example, formulate the evaluation mechanism as shown in 〈Table 2〉, stimulate the unity and cooperation of all members, give full play to their talents, promote common development, and cultivate their ability to express themselves.

5.4 Training of Practical Innovation in Practical Teaching

Any teaching activity of computer science must go through three processes of abstraction, theory and design [Ministry of Education College Computer Science and Technology Teaching Steering Committee, 2008]. The design here refers to the new practice under the guidance of correct theory, that is, to solve new problems with new methods, new ideas and new insights. In the current era of information explosion, students will always encounter new problems in their work. The most concerned learning ability of enterprises is also the development potential based on practical innovation.

The cultivation of practical innovation in database teaching practice is mainly reflected in two aspects. One is the role setting of the experimental items in class. First, students choose their own role, and then put forward the specific experimental content from the perspective of role. Second, in the practice of database projects, students are encouraged

to draw up their own topics and use evaluation mechanism to support students' innovative design. The instructor participates in the analysis and discussion process, but only plays a leading role, not a leading role. For the unique function or innovative realization method to give affirmation, encourage students' innovative practice.

5.5 Effectiveness of Practical Teaching Under the Guidance of Core Literacy

Aiming at the students who implement the database practice teaching based on the core literacy (referred to as the group A) and the students who teach in the traditional way (referred to as the group B), the online questionnaire survey is conducted by using the Tencent questionnaire tool. The questionnaire consists of six dimensions of core literacy, asking whether the content, implementation methods and process of practical teaching can help to improve the corresponding core literacy. There are 4 questions for each dimension. Students can choose "yes" "general" and "no" to ask whether the answer has been improved. If more than 3 of the 4 questions are "yes", then record it as promotion, otherwise record it as "not promotion". A total of 95 questionnaires were collected from the group A and 46 questionnaires from the group B. The results of the questionnaire are shown in 〈Figure 2〉, which is expressed by the proportion of the number of students below the average and the number of students in the total sample. The group A improved in six dimensions, especially in the responsibility (86.3%) and innovation practice (77.9%), which were 10.2% and 17.0% more than the group B, respectively. The students who did not get the improvement were significantly less than the group B. In addition, in the process of the

construction and implementation of the practical teaching system, there is no training in the design of humanistic details and healthy life dimensions, but it also has a certain improvement compared with the group B, which is an additional gain, and it is a part that needs further research in the future teaching design.
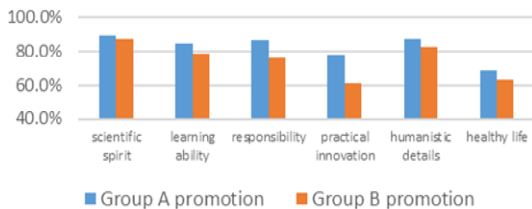
〈Figure 2〉 Comparative Analysis of Practical Teaching Effect

6. Conclusion

Enterprises and society require students majoring in computer not only to have strong learning ability and innovation ability, but also to get along with others harmoniously and work together. This paper takes "Database Principle" as an example, through the process of building a practical teaching system based on core literacy, the following achievements are obtained: first, the role model enriches the experimental content and form, encourages students to criticize and question, dare to explore, and learn to learn to learn; second, the group defense link is added to stimulate students' sense of team cooperation and improve personal ability at the same time Third, we should adopt the evaluation mechanism that attaches importance to innovation practice and team cooperation ability to cultivate the sense of responsibility.

Questionnaire survey data shows that after the implementation of database practice teaching based on core literacy, students have improved in six dimensions, among which res-

ponsibility and innovation practice have improved significantly. However, no measures have been taken in the humanistic connotation and healthy life dimension, but it has been improved to a certain extent compared with the control group, which is the content that needs further study in the future teaching design.

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■ Author Profile ─────────────

Hua JIN

Hua Jin was born in 1970, master of engineering. Engaged in undergraduate and postgraduate teaching work in Yanbian University, College of Technology, with the main research direction of database, information security and Internet of things application technology.