Research of Programming Thinking Developing in High Programming Language for Deaf Students

Li Hanjing   LiuHui

Special Education College of Beijing Union University

tjthanjing@buu.edu.cn

Abstract: For the fear in teaching and learning of high-level language programming courses, this paper proposed the spiral teaching method based on Scratch, at the same times we coordinate with the director type teaching method. This method experiment in computer science and technology class which is the hard-of-hearing or deaf junior majoring in, and achieved good results. After studied 64 class hours, they can participate in the computer application contest for entire undergraduate with hearing students, and got prizes.

Keywords: high-level language programming, deaf, computational thinking, Scratch

About the author: Li Hanjing, February 1974, female, Ph.D., associate professor of Special Education College of Beijing Union University. Research direction is on accessible computational linguistics and sign corpus.

1、Introduction

In the 1980s, we were talking about the transfer from industrial society to the information society, but in the 1990s we began talking about the knowledge society, we recognized that only when the information transferred into knowledge, the information could be useful. In 2007, Mitchel Resnick, MIT's Professor, called today's society as the creative community, he reckoned that success is not only based on what you know and how much you know,but also on the ability to consider in a creative way and action[1-5]. In the creative community, how to train the deaf or hard-of-hearing student's ability for the program designed has become one of the important tasks to support them to effectiveset foot on the community.

For the deaf or hard-of-hearing student, Chinese special educators conducted extensive research and exploration in mode of the communication, the psychological barrier in learning and the teaching method and so on. Professor Zhang Ningsheng said "Communication problems is the core issue of deaf education, ..., in the field of deaf education, the lowest effective aspect is language teaching,and the subjects which related to language ability are all affected by it" [6]. Programming course is just related to the language ability. Many special educators reflected the low efficiencies and difficulties in this course.

In the information processing perspective, solving programming problem and solving mathematical word problem havethe same approaches. The 4 stage theory putted forward by Polyais also applicable to solvethe problem of programming process, namely: understanding the problem; designing solving plan; implementation plan;evaluation to solve the problem whether reasonable or not[7]. Many researchers believe that the deaf or hard-of-hearing student and the hearing students have no qualitative difference in cognitivestructure of solving mathematical problems, the reason of the mathematics level of the deaf or hard-of-hearing student falling behind the hearing student is not due to the defect of some corecognitive, but is affected by the backwardness of their languageand experience, and alsois related to the improperteaching method [8].

The difficulties of the deaf or hard-of-hearing student solving mathematical word problem are in the lowlevel of the metacognitive ability, too fast when solving the problem, too impulsive, and lack of thinking and reflexing judgment. The result is released by Mousley et alin 1998 [9]. In 2003, Hyde found that somestudents didn't have any confidence in understanding the word

problems, they tend to find the keywords of the problem, and answer the question according to prompt of the key words, so that it leads to many errors [10]. In China, in 2002, Changchun Bai suggested that the factors include their ownfactors, such as slow development of the language of the deaf or hard-of-hearing students and cognitive defects ,and alsoinclude objective factors, such as the lack of mathematical knowledge application environment and unreasonable compilation of teaching materials and so on [11,12]. Suhong Yu discovered the reason why the deaf or hard-of-hearing students cannot establish the correct model is not the lack of logic and mathematic knowledge, but because of reading without the law and weakability for the understanding of text semantic. At the same time, SuhongYu's given intervention training was used two means, the visual hints and teacher questioning.

In China,the teaching methods of the programme design have heuristic teaching method, case teaching method, task driven teaching method, intuition thinking method and so on. Among them, the teaching methods used in the course of the programme design for the deaf or hard-of-hearing college students are CDIO engineering education model (conceive -design-practice-operation) [13] and asynchronous education theory [14] which suggested by Professor Li Shifa from Hubei University [14].

At present, the teaching of high-level language programming course has the following characteristics: the initial learning on grammar; the behaviors of using prime and drawing a simple line as a programming example those without the students' interest and experience, seldom to introduce the processing of exception and optimization in the context of programming. These characteristics of the programming highlight the difficulties, but obliterate the learning interest of the students.

The deaf or hard-of-hearing student's fear mentality for difficulty, the weak Chinese reading ability and the teaching method of attaching great importance to the knowledge, those aspects lead to bad learning result of programming course, even difficult. This article starts with the common of the learning method and teaching method, making use of MIT Scratch platform, hiding grammar learning, highlighting the practical requirements, and constructing the meaningful social teaching situation in the perspective of students, based on the self-reference effect theory to feedback learning result, and the teacher as the director, so as to keep the student interest and get the satisfaction and pleasure in learning.

This article has the following several aspects: Scratch introduction; high-level language programming curriculum status, the difficulties in teaching and learning of this course on the hearing student, as well as difficulties and confusions in learning of the deaf or hard-of-hearing college students; based on the introduce of the spiral Scratch learning method, students engine the class, reducing programming cycle; test this method in the classroom of the deaf or hard-of-hearing students; finally, summary.

1、 Introduction of Scratch

The Scratch programming language is developed by the MIT Media Lab's Lifelong Kindergarten research group leading by Professor Mitchel Resnick. For this project, Professor Mitchel McGraw won the 2011 Education Award. Scratch software development platform is to provide a method to allow people who never thought become a programmer can learn to write program. Program writing can be like building blocks though this platform. In the process of creating Scratch program,the people in different ages will learn the concepts of mathematical and computer programming, and also improve their digital fluency, and problem-solving ability. They

will be more creative to express themselves, more structured to think and more sensitive to know the innovative technology in the surrounding.

The interface of Scratch software platform development is shown in Figure 1 [1]. In the module area (Block Palette), it provides 8 types of modules, including action, shape, sound, brush, control, perception, operator and logical operator, variable. Variable, control, computing, arrays, interaction and the other basic concepts of the high-level programming language design are also covered in these modules. With the thought of "building blocks", the learning of abstract concept is subtly transferred into the building module game, so that student can unknowingly master these concepts in happiness.

When writing scratch program, for each character in the Script List,the modules in the module area set up according to the functionin the script area. When we want to see the result, we can click on the little green flag at any time and we will see the graphical result on stage immediately.

Scratch works are released in the Scratch website publicly (http://scratch.mit.edu). Students can share, discuss and re-organize the other's work. Currently, there are more than 989,570 registered users, the number reaching 292,980 who did scratch works. The person Using Scratch aged from 5 until 70 years old. The number of 12 years-old user is reached 50,000. The age distribution is shown in Figure 2. But there is no any report or literature that can be searched about the deaf community using this platform.
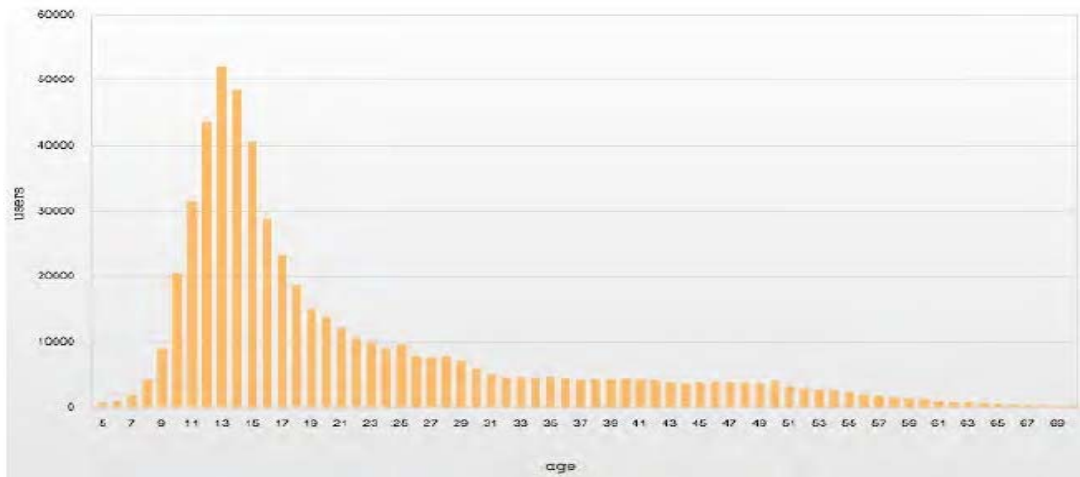

Figure1 Scratch Graphicsoftwaredevelopment platform

Figure2 The age distribution of Scratchprogramming language users

2、The status of high-level language programming course

"High-level language programming course" is compulsory for computer science and applied (undergraduate programs) and computer applications（specialist professional）, and many non-computer professional also learn the course [16,17]. However, at present there are many difficulties when the students learn the course. The prominent difficultiesare in conceptual complexity, numerous rules, flexible and highly logical. These result that the student have no idea to start, and after learning more than 40 class hours, the course having 60 or 70 class hours, the student have no ability to write a complete program successfully. In the perspective of the teacher, there are also many difficulties in Course teaching, and the key point is how to balance the relationship between grasping the concept and programming. With little concepts have been taught, arranging the student to write program, there will be result of program execution is sample,making students cannot understand the operating mechanism, the program is full of mistakes, and compiling unsuccessfully. Instead, using the approach teaching concept, the teacher prepare program and display the result, and there are also the drawbacks of dull learning and poor effect of just looking and no work. This course has become the trouble of student learning and teacher teaching, even coming into the fear of the "block Land Rover." As logical basis, programming idea is established not proper in this course; the latter study of the computer major courses will be led to adverse consequence.

Those difficulties mentioned above also exist in the deaf or hard-of-hearing student when learning programming language. Meanwhile, the deaf or hard-of-hearing students have different individual characteristics with the hearing students. The single examination and enrollment mode causes weak foundation whenthey entrance college. Entrance examination subjects are Less than the common, such as computer professional only taking in four subject examination of the language, mathematics, English and physics, and the exam is much easier than the common [13]. The physiological characteristics of hearing impairment cause deaf students quite different in cognitive ability of individual. A survey shows that: the deaf or hard-of-hearing student is deaf over the age of 0-3 years old, which impacts the ability formation of abstract thinking and imagination. These factors lead that they do not grasp too much or very good of the basic logic concept. Andthe communication between the hearing teacher and the deaf or hard-of-hearing student exist the varying degreebarriers.

In the class of "High-level language programming course" including 64 class hours in author's

school, the teacher only can accomplish usually teaching content of 48 class hours or even less, leading other content of two-dimensional array, file, and multiple loop cannot be taught. For the concept and algorithm of the variable,seeking the largest number that have been taught, the performance of the students in the exam is also unsatisfactory, and more than 50 percent of the students did not remember the algorithm of seeking the maximum number.

3、Spiral learning method

In the class of high-level language programming --- C language, the author views every deaf or hard-of-hearing student as a mature software developer and letevery the student to accomplish a complete software development cycle in programming task. Seven steps of development cycle are constituted the basic steps of the spiral learning method, shown in Figure 3. However, when the hearing-impaired student study this course without any foundation of programming language, how to bypass the link of language grammar learning? As the "low threshold" feature of Scratch development platform, it enables the student to smoothly enter into the role of software developer with Scratch platform in the C language classroom teaching. What's more, the student can learn variable, control, event, object, and a series of logical concept in the Scratch programming environment. Then, the introduction of C-language development environment, each programming task is also a complete software development cycle. Because that the students are familiar with the concept of variable and control by learning Scratch, students can learn grammar through programming examplesin C language learning, which can reduce the boring of the complex rules in teaching to improve learning effect.
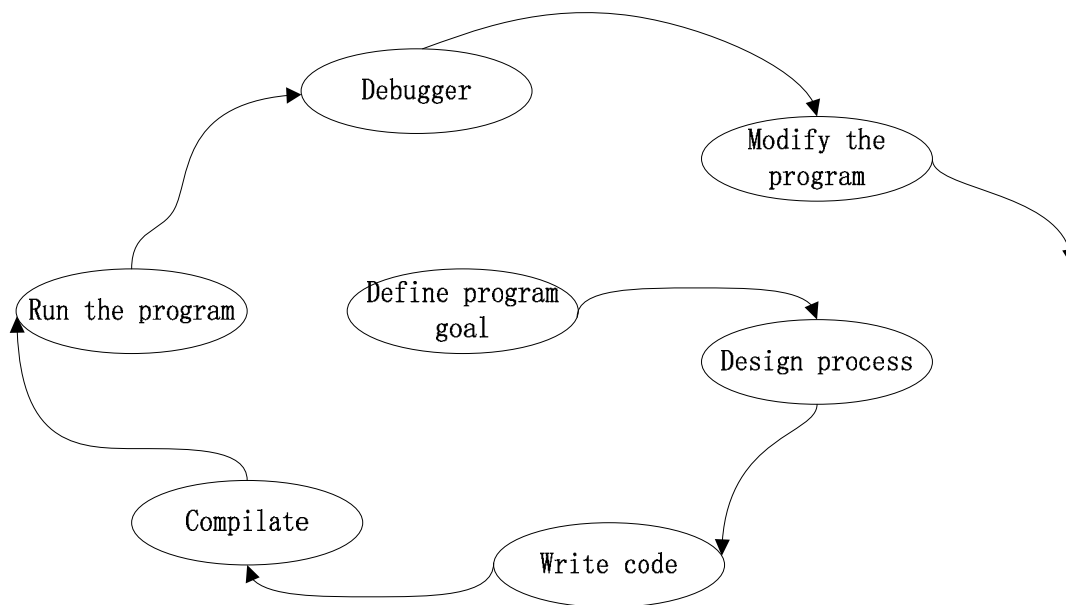

Figure3 the basic graphic of Spiral learning method

In the teaching, the author distributed teaching time to Scratch and C language according to the proportion of 3:7. For example, in a course of 64 class hours, firstly, the teacher took 18-20 hours to arrange the student to learn Scratch programming language and software development platform. In the last 44-46 class hours,the student learned the C language and related software development platform.

Each programming task is the implementation of a complete spiral link.Each session it have

adopted the director-style pedagogy.

For example, Scratch software development platform was demonstrated to the students when the course starts. Within 5 minutes, the teacher completed a Scratch work tomaximize to stimulate the studentcuriosity for the professional course quickly. Then the students themselves enjoyed a large number of Scratch Works in 10-20 minutes, so that their own novel ideas expanded rapidly. After that, the teacher let the students do a Scratch work personally in 15-20 minutes immediately, making the students' ideas from hazy into reality and establishing the curiosity for new knowledge and self-confidence for themselves.The students used one class hour (45 minutes), to complete a very fun program work, to experience a series of logical concept unconsciously and usedit successfully. The following was another showcase for the students' works. By showing, they could get lots ofinformation of strengths and weaknesses, language, platform technical on their own work. The Students could not wait to enter into the next spiral learning link with heartfelt delight and to improve their own work. Through continuous improvement of the work, the students finished the learningof the Scratch.

Scratch works of the student were the bridge, converting the C language to the Scratch language. The teacher quickly used C language syntax to realize a small function of student work in 15-20 minutes. During the conversion process, it can use a nature way to introduce the C language variable, statements, and other basic concepts and rules to the students. The curiosity enables the students to use the C language successfully.

In the entire process, the teaching principle,the core of the method, is not to let the students feel the blunt of learning, instead they feel it fun to use, even as a "play." Such principle can keep students' ability of innovation.

The knowledge presentation of the history, development, trend of Programming language could intersperse in the show of the students' works.

5、The effect of Spiral learning method

The author tested the spiral learning method in her own classroom. The educational object is the hearing-impaired students in the first grade second semester. Their major is computer science and technology. The Class has 17 students, and three students have learned VB language in special education school, the other students without the foundation of computer language. The teaching time was 64 class hours in total.

After 20 class hours learning of Scratch, every one of the 17 students finished a complete Scratch work. The Works contain interactive game, interactive quiz animation, mini-calculator and so on. All of the works have used the concepts of script,variable, control, arithmetic operator, logical operator, event, object .The works, whichused circulationcontain 2-3 layers, were accounted for 50%.

In the next 44 class hours, the students completed the learning of C language, and do a calculator. All of the 17 students were able to complete their own calculator. All of the works could conduct mixed operation, and could execute multiple times according to the user's preference. In 20 class hourslearningofthe C language, 40%students 'workcan achieve the function above.

In Computer Application Contest of the school-level,all the selected four groups'works got prize, first prize 1; second prize 1; third prize 2.

The author used the simple method of the C language in the previous teaching. When the Course started,the author taught the students the basic data types of C language. At the end of

the 64 class hours learning, only 20% of the students were able to complete the calculator work, and other students works only could complete once math calculator andrepeatedly execution is not very well .

By contrast, the spiral learning method based on Scratch achieved good result in high-level language programming course.

6、Summary

In this paper, for the fear in the teaching and learning in the high-level language programming course, the author specially designed the spiral learning method based on the Scratch, at the same times we coordinate with the director type teaching method. Scratch is a new programming language designed by the professor of the MIT Media Lab. Its design principle is accessible for all. Whether you want to become a programmer, you can exercise the fluency of using technology by the Scratch. What's more, the Scratch programming language completes to introduce the concepts of mathematics and computing, such as variable, control, operator, event, object and so on, and by using module shape, color, glue matching degree and the other graphical element to let the students complete language learning and calculate thinking in the entertainment way. The method presented in this paper actively introduces the Scratch learning into the course. It can enable the students to write a complete program quickly, to maintain their curiosity for new knowledge and to build their self-confidence for knowledge acquisition.

The design of the spiral Learning method is to reference the graphical element and the learning of the grammatical aspect from direct study into the conscious learningin the Scratch software development platform, so a full part of the spiral method can be completed in a very short time.The students can maintain novel idea and creative ability in the spiral learning method. The teacher and the student all can avoid the difficulties in direct teaching and learning of the logic concept.

This method is introduced to solve the individual differences in the aspect of foundation and cognitive of the deaf or hard-of-hearing Students. The hearing-impaired Students of different levels are guided by their own basic knowledge and cognitive skill, and dominated by their own curiosity to enter the start stage of the programming language learning. The starting points of the students are different, but the holding force of curiosity and self-confidence is consistent. The Spiral learning method is repeatedly, everyone's starting point tending to be the same.

The method was tested the freshman in the class of the hearing-impaired students whose major is computer science and technology, and achieved good result. At the end of 64 class hours'study,they could participate in the computer application contest for entire undergraduate and the main participants were the hearing students, and they all have made awards.

This teaching method is still in the experimental stage, and there are some details needed further systematize. For example, depending on the different basis of the students,how to control the ratio of learning time for C language and Scratch reasonably; under the premise of ensuring efficiency,the teacher how to allocate the energy reasonably to provide the student programming personalized guidance; the teacher how to skill fully make the students actively exercise the rules specific to the C language in their own programs, such as the range variable, data type conversion and so on. The problems like that and to write the teaching materials, which are suitable for the deaf or hard-of-hearing student, are the main works of author in the future.

7、Acknowledgement

References

1、 Resnick, M., Maloney, J., Monroy-Hernandez, A., Rusk, N., Eastmond, E., Brennan, K., Millner, A., Rosenbaum, E., Silver, J., Silverman, B., &Kafai, Y. (2009). Scratch: Programming for All. Communications of the ACM, vol. 52, no. 11, pp. 60-67 (Nov. 2009).

2、 Rusk, N., Resnick, M., & Cooke, S. (2009). Origins and Guiding Principles of th ·e Computer Clubhouse. In Kafai, Y., Peppler, K., and Chapman, R. (eds.), The Computer Clubhouse: Constructionism and Creativity in Youth Communities. Teachers College Press.

3、 Resnick, M. (2007). Learning from Scratch, Microsoft Faculty Connection, June 2007.

4、 Maloney, J., Resnick, M., Rusk, N., Silverman, B., &Eastmond, E. (2010). The Scratch Programming Language and Environment. ACM Transactions on Computing Education (TOCE), vol. 10, no. 4 (November 2010).

5、 Brennan, K., &Resnick, M. (2012). New Frameworks for Studying and Assessing the Development of Computational Thinking. Proceedings of the 2012 annual meeting of the American Educational Research Association, Vancouver, Canada.

6、 Zhang Ningsheng. On the Deaf Communicate Modes and Deaf School Language Teaching. Bijie University paper. 2012, 6 (30). P54-60.

7、 Polya G with, Liu Jinglin, Cao Zhijiang, ZouqingLian translation. Mathematical discovery: on understanding of problem solving, research, and teaching. Beijing: Science Press, 2006.

8、 Yu Su-hong. Deaf solve addition and subtraction word problems Cognitive Research, East China Normal University, Shanghai, doctoral dissertation.

9、 Mousley K, Kelly R R. Problem-solving strategies for teaching mathematics to deaf students. Americn Annals of The Deaf, 1999, 143(4): 325-336.

10、 Mery Hyde, Robyn Zevenbergen, Des Power. Deaf and Hard of Hearing Students. Performance on Arithmetic Word Problems. American Annals of The Deaf, 2003, 148(l): 56-64

11、 Bo Changchun. A Review on the Application Problem of Maths Teaching onMiddling Grades in Elementary schools for Deaf-mutesChinese Special Education, 2002, 34 (2): 25-27.

12、 Sun Ye Social .Psychology, Beijing: Science Press, 1987:159.

13、 Zhang Shuzhen .Engineering students of Practice Teaching Deaf Education and career Based on CDIO thinking . 2011, 21 (697). P169-170.

14、 Kai. Deaf higher engineering education Asynchronous Teaching and Practice of Education and Vocational. 2011, 20 (696). P150-152.

15、 Kai. Task-driven teaching mode in deaf education application. Suihua University. 2013, 1 (3). P57-59.

16、 Xu Xiaoqing, Li Xiaodong. (2009) "High-level Language Programming" Course Teaching Reform and Practice, No. 3, 2009. P46-47.

17、 Li Xiaodong, Xie Na velvet, Xu Xiaoqing. Study on Teaching Method for Training Innovative Talents in High-level Language Programming Teaching. Beijing Electronic Science and Technology University Vol 18, No. 4, December 2010. P86-89