Research of Self-regulated Learning in Teaching of Assembly Language Programming Combined with Development and Application

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Abstract. Self-regulated learning in teaching of assembly language programming has been studied professionally for more than three years. It is proved that this method is a good way for undergraduate students to understand the course deeply, but this method doesn't work effectively in cultivating students' ability of practical development. In response to this disadvantage, the self-regulated learning method combined with development and application in teaching of assembly language preprogramming is studied in this paper. And C language and Assembly languages Transformation System was developed to supported this new method. The study result shows that this method can enlarge students' eyes and also can improve their practical ability.

Keywords: Teaching of assembly language programming; Self-regulated learning; Development and application; C language and Assembly languages Transformation System

1. The Present Status of Self-regulated Learning About Assembly Language Programming

Assembly language programming plays a significant role in the field of computer teaching. During the past few years , the research and practice of self-regulated learning[1][2] in teaching assembly language programming which based on the "Online learning and examination system of BJUT"[1][3] have made such great achievements in students' preview before class, class activity, assignments after class and term examinations. However, this improvement does not mean that self-regulated learning in teaching of assembly language programming is perfect and no deficiency at present, possible shortcomings mainly display in:

1.1. "Online Learning And Examination System Of BJUT" Is Just An Element Of Self-Regulated Learning In Teaching Assembly Language Programming. For Further Improving Students' Capacity, This System Can'T Be Fully Depended On.

Self-regulated learning depends on students themselves' awareness and cognition of one's action. At beginning, because students never tried this way to have class before, their curiosity drove themselves to preview, read, and do homework access to "Online learning and examination system of BJUT". And they feel like coordinating with teachers' new teaching plan oriented to their self-regulated learning. But after having a few classes, curiosity disappeared and they gradually lost interests in this new way and never want to interact with teachers. Ultimately, the outcome of this new teaching mode is not so ideal anymore.

To solve this problem, teachers discussed comprehensively and concluded that "Online learning and examination system of BJUT" is only a tool, just a part of self-regulated learning in teaching of this course, which is never the basic power to prompt students to learn assembly language programming by themselves.

1.2. Lack Of Cognition Of Assembly Language Programming Is The Root Of Deficiency.

1) Assembly language programming difficult is difficult for students.

Assembly language is one of the most difficult computer languages. The first reason is assembly language programming relates with hardware directly, logic is machine logic, concrete but not abstract. The second reason is assembly language is not used as widely as other high-level languages. The two reasons

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make students hesitated to learn assembly language programming. They don't have enough confidence to learn it well, even they can learn well, and they would think that they have no chance to use. Therefore students tend to study those which are widely applied and relatively simple computer programming languages, such as objected-oriented languages. Thus Students do not spare such lots of time and energy on assembly language programming even there is "Online learning and examination system of BJUT" to supply enough learning materials.

2) Students have limited understanding with assembly language programs' development and application.

In school learning, assembly language programming is concerned with the two courses, which are "Principles of Computer Organization" and "Embedded System Programming". In these two courses, only the principles and rules of assembly language are mainly taught but the development and application are almost not concerned. Until the end of the term, some students even don't know any other assembly languages such as ARM, MIPS, Power PC and so on. And they actually don't know the important role that the assembly language plays. They can't master assembly language very much, let alone they can grasp the essence of its programming.

In short, students understand assembly language programming limitedly because of assembly languages' great differences to other high-level languages they are familiar with. As we all know, assembly languages' grammar and program structure are very different to high-level languages. The assembly language is only what they learn from teachers', there is no self-motivation for them to learn assembly language. This is why lack of cognition of assembly language and assembly language programming is the biggest bottleneck of the self-regulated learning. This is also why, at present, the teaching obtains a certain achievement and has no more breakthroughs in practice.

2. The Teaching of Assembly Language Programming Combined with Development and Application

A Self-regulated learning survey [4] revealed that the motivation of self-learning mainly derived from the needs of application. In another word, the practical project can inspire students to learn the required knowledge. Therefore, aim at resolving the problem happened, self-regulated learning in the teaching of assembly language programming combines with development and application is easy to think of. Only this way is more approachable to the practical work environment and also can make students understand assembly language programming deeply, especially its application in the embedded system projects which is very popular at present. If they realize that mastering this technology may be good for their future career, they will learn by themselves. From then on, self-regulated learning research can attributes to computer education which also is the motivation for this research in the teaching of assembly language programming.

Actually, the assembly language programming is taken seriously again should contribute to the application of the embedded system expansion driven by development of the computer chip technology. Every kind of chip structure corresponds to the specific assembly language instruction set, so assembly language family also expands unceasingly. In the development of embedded systems, the assembly languages mainly are coded in real-time embedded systems to initialize some important varieties related to hardware or together with high-level language such as C language to make the programs can work in the balance between performance and efficiency.

For this reason, classroom teaching of assembly language programming based on the self-regulated learning combined with development and application is more applicable and forward-looking. Computer language learning is originally a procedure of learn-and-do. Only learning makes students pass the exam but can't work in the company. Thus this method not only can improve the function of teaching but also solves the contradictions between schools and enterprises to some extent. General implementation plan as the following figure:
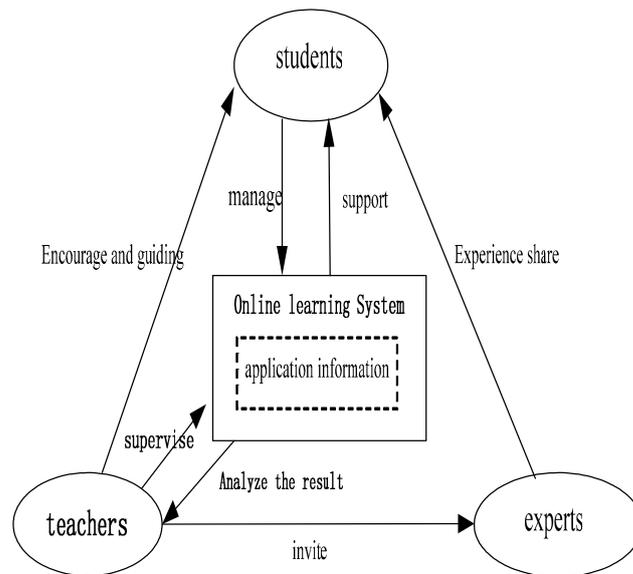
Figure 1. Self-regulated learning in teaching combined with development and application

3. Implementation of Self-regulated Learning in the Teaching of Assembly Language Programming Combined with Development and Application

3.1. Teaching Plan Must Be More Inculcated.

Knowledge in textbooks is always far behind the practical technology in the enterprises, for example, assembly language programs are coded by Intel 80x86 instruction set in class, but ARM is the most popular assembly language, even 80x86 instruction sets are expanding, too. Here must be questioned by students "Why we learn 80x86 but not ARM or the newest serials of instruction sets?" So teaching plan must include the contents that make students recognize the necessary of studying the old 80x86 and the relationship and differences between 80x86 and other assembly languages, such as ARM. By learning 80x86, students can perceive the essence of assembly language. Teachers' most important task is not teaching them what to learn but how to learn. This also belongs to the field of students' confidence teaching and very helpful to students' develop career.

3.2. Class Teaching Applies "Application Information" Content, The New Module Of "Online Learning And Examination System Of BJUT".

This mainly target to help students get the newest information of assembly language. With the system's constantly improving, teachers can authorized to students manage the pages and supervised them. After all students know what they really care about.

3.3. And Now We Are Developing A New Tool To Help Students Understand Assembly Language Programming Comprehensively.

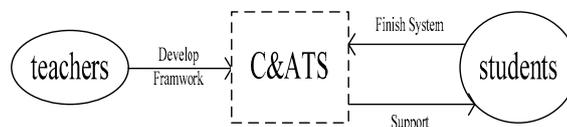This new tool is C language and Assemblers Transformation System (C&ATS).

Figure 2. Application of C&ATS

C&ATS is used to transfer one assembly language program to another's. That means you can choose assembly language program you have and the assembly language you want to transfer. Directly click transfer button will be OK. At the first beginning, this software was developed to make students understand the difference and relations of the assembly language programs. But it subsequently turned out that application of this system is really benefit for students to learning assembly language. So now students joined the system's development and system maintenance. This system is designed very flexibly, so any two assembly languages' module of transformation can be integrated in this system. There are the following reasons for students using this new tool of learning:

1) C&ATS helps students master some important basic definitions and rules in assembly languages.

The basic definitions in assembly language learning include: instruction sets, register numbers, register bits wide and some special rules in programming (head definition, end operation, pseudo instructions, tags,

etc.). During the development of system, all of them must be considered. If don't learning these language well, you will never write the good transformation program. Students are very interested in this project and their participation brings a great deal of good ideas.

2) C&ATS help students know and master other assembly languages besides 80x86.

As to transformations, there must be two languages. First must be 80x86, this ruled by the course and term examination. Another language can be chosen by students freely. Students also can chose to compile high level Language like C to 80x86. And the students joined to develop this system can use any language platform. As long as you can support an executable file, your code will be a part of the whole system.

3) C&ATS helps students write comprehensive assembly language programs.

At present, hardware is updated very quickly, so even the bottom code of assembly language is often rewriten in the practical environment. In order to keep the compatibility of the system, programs are coded by more than two languages occurred commonly. So concerning this condition, students would think whether they could write assembly language together with other languages to implement a specific function or not.

Figure 3. Illustration of C&ATS

3.4. Assignments Focus On Basic Knowledge And Also Reflect Application.

Teaching works does not only focus on the basic knowledge examination, but also cares about cultivating the students' capability of application. All the teachers hope their students can do as their schedules, however, the results sometimes come to the wrong way. One aspect is students copy others' homework and can't pass the examination. The other aspect is many students can't learn to meet the needs of society. Discussion by teachers, the teaching of assembly language programming is being or is ready to adopt the following methods:

1) Basic knowledge teaching and learning.

From the very beginning learning, students haven't master assembly language programming overall. Assignment should be some reading task which includes 80x86 and some other assembly languages, such as ARM's. Because now ARM products are very familiar to students, like cell phones. What's more, nearly all the books of embedded system are based on ARM.

2) Inviting some excellent assembly language programmers to share their experience with students.

Make sure that students can have access to the real development of assembly language programming. Inviting professors and developers to share experience with students is the best way. Their success can urge students learn assembly language programming. In addition, development videos are also very useful.

3) Improving the complexity of the assignment.

It's time to improve the complexity of the assignments after students grasp the structure of program of assembly language. The assignments must be necessarily similar to the real projects in enterprises which

highlights students' teamwork: different persons or groups commit to different parts of work; allow students write the program using other assembly languages or other high-level languages, such as C, besides 80x86. If students can finish the assignments, they must understand basic knowledge deeply and read substantial books or related data, meanwhile this can avoid them copying each others' assignments.

5. Conclusion

Until now, although self-regulated learning in teaching of assembly language programming is in the stage of researching and exploring, it's still proved that the researched method mentioned above has certain advantages than the traditional teaching method, especially in the teaching of computer language and program design courses. This paper mainly introduced the present status of self–regulated learning in the teaching of Assembly language programming and analyzed the necessary of combining with development and application in teaching this course supported by "Online learning and examination system of BJUT" and C&ATS. Overall, this method is a positive cycle for students' study and practice, also it plays a significant role in exploring computer language programming education and finally it really should be researched more and applied widely.

6. References

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