An effective teaching method for a Linux course

Hongyu Feng & Yancui Li

Henan Institute of Science and Technology
Xinxiang, Henan, People's Republic of China

ABSTRACT: Given the advantages of the Linux operating system and the demands of society, many colleges and universities have recently started Linux courses. In the study for this article, the characteristics of a Linux course were defined, and college Linux courses were analysed. The findings were that traditional teaching methods are limited and that only by reforming them will they be improved. For computer science students including those who specialise in networking, a teaching method based on case studies and a task-driven method is presented in this article. Specific details of tasks and cases are explained. Finally, the student scores using the traditional method are given and the new method is outlined. The results show that the method presented in this article benefits students. A teaching method that makes use of both case studies and tasks is suitable for a Linux course and it is conducive to training skilled graduates for the modern workplace.

INTRODUCTION

Linux is a Unix-like and POSIX-compliant (Portable Operating System Interface for Unix) computer operating system available with free, open source development and distribution. Since it is safe, efficient, powerful, open source, and has good compatibility and transferability, Linux has been widely used in key areas such as the army, finance, telecommunications and security. Given its extensive use, enterprises need a good deal of Linux application and network development personnel. Colleges, scientific research institutions and other researchers use Linux in their research. The Chinese Government recognises Linux's significance and it heavily promotes the use of Linux. Colleges also have begun to attach importance to Linux and to develop Linux courses. Linux courses in colleges are of two types: principles of operating systems and system management.

Courses about the principles of an operating system should impart theoretical knowledge of operating system procedures. Courses about system management should include a study of system structures and operating principles, and make students familiar with a variety of Linux servers, the technology of Linux systems, configuration management, maintenance and management of the network environment. Linux always has had network operating system capabilities. In spite of its simple commands, in plain text, Linux has a very advanced network, script and security capabilities. As a professional network domain teacher, one of the authors has developed a Linux syllabus and teaching plans. A Linux systems management course is used as an example to discuss teaching Linux.

Linux is a very practical course, with theory and practice taught together. Traditional unidirectional, force-feeding teaching methods are not suitable for this course. As Linux has many commands, merely explaining commands one at a time is dull and boring and does not inspire students' interests and creativity. Students should be helped in laying the foundations of Linux systems and server management. Teaching should take account of students' future employment. What students will need in the future is what should be taught now. Reviewing the literature about teaching operating systems [1], a practical-based teaching system was proposed. This can arouse students' interest in learning about operating systems, and develop the students' abilities in systems management and programming. The methods for teaching Linux in China include the project-driven teaching of Linux application server management [2], building Linux systems [3], the working process method [4] and task-driven teaching [5]. The various teaching methods, however, lack theoretical support and data verification support.

In order to make students understand and master the course, a case study and task-driven teaching method based on the authors' teaching experience over many years was introduced, and is outlined in this article. The case study method is a teaching approach in which students are presented with a case, putting them in the role of a decision maker facing a problem. Many researchers have studied case studies from different aspects, such as theory, design and applications in computer science [6-8]. They found that case studies are useful for some computer courses, but nobody has used it for

Linux teaching to the best of the authors' knowledge. The task-driven teaching approach embodies the practical characteristics of a Numerically Controlled Machining course, which trains high-quality personnel. The task-driven teaching method is adopted to improve the quality of practical teaching, and to cultivate abilities and creativity. The task-driven approach can improve teaching by developing the student's creativity and independent thinking [9][10]. As for the teaching, a flexible teaching model was chosen using both the classroom and the computer room.

CASE STUDY METHOD

To restate, the case study method is a teaching approach that consists in presenting the students with a case, putting them in the role of a decision maker facing a problem. It is generally believed that the case-study method was first introduced into social science by Frederic Le Play in 1829 as a handmaiden to statistics in his studies of family budgets. The use of case studies for the creation of a new theory in social sciences was further developed by the sociologists Barney Glaser and Anselm Strauss, who presented their research method, Grounded theory method, in 1967. The popularity of case studies in testing hypotheses has increased only in recent decades [11].

One of the areas in which case studies have been gaining popularity is education and, in particular, educational evaluation. In a case study classroom, the instructor and the student have different roles but each is dependent on the other. Instructors are generally experts, but they rarely share their expertise directly. The case study method is a teaching method that is largely used in business schools. For instance, it has been used at the Harvard Business School since its founding in 1908 and at the Richard Ivey School of Business since 1921 [12]. It is also used in some public policy schools, such as the John F. Kennedy School of Government at Harvard University. Case study teaching emphasises student instruction by discussing a case on the basis of the teacher's description. This method is often applied in more professional teaching programmes.

TASK-DRIVEN APPROACH

Task-Driven Approach and Constructivism

The task-driven approach is a teaching method based on constructivism learning theory. It turns the traditional teaching idea of imparting knowledge into a multidimensional interactive idea, which gives priority to students' solving problems by completing tasks. Meanwhile, *task-driven* changes teaching into *inquiry* teaching. Each student comprehends the problem, comes up with proposals and solves the problem, using shared knowledge and experience [13][14]. The task-driven approach encourages the unconscious retention of knowledge.

Steps in task-driven teaching include the following:

1. Create Situations: by creating specific circumstances, teachers help students acquire knowledge similar to what would be acquired in real situations. The first thing is to create a real learning situation concerned with a current learning theme and, then, instruct students to expand their knowledge using real goals.
2. Set Goals: in designing a task related to a study theme, the teacher makes students envisage the problem directly. As a result, the solution to the problem may encourage students to use their knowledge to understand or analyse the current problem. What is more, it can provide an ideal platform to combine and broaden the new and old knowledge. This is the main feature of inquiry teaching, i.e. to build knowledge by solving problems.
3. Task Analysis and Completion: students should learn autonomous and co-operative learning. After the tasks are given, students should analyse the tasks; the problems needing to be solved, the knowledge they should master, and, then, find a solution. At the same time, teachers provide relevant clues and materials. By communicating and co-operating with each other, students develop a deeper understanding of the issues.
4. Evaluation: there are two parts to the evaluation. One is the evaluation of process and the solution to the problem. The other is the evaluation of autonomous and co-operative learning ability. Teachers make comments and help students [15].

APPLICATION OF THE CASE STUDY METHOD AND THE TASK-DRIVEN METHOD

Applying the Case Study method

In the Linux class, the teacher connects content of the course via the case. Students not only learn the basic knowledge but also its application. For example, it is hard to make students understand Linux setup procedures by theory alone. When teaching this, the teacher should divide it up into three cases. The first case is designed to solve the problem of a user forgetting the Root password. The process for the case is to start the computer and enter the Grub Menu Interface. Then, through entering edit mode on the BootLoader Menu, Grub allows entry into single user mode. After that the user can get Root privilege without inputting a password and can modify the Root password via the password command. Then, the computer should be restarted. The main idea of this case is to help students understand the basic process of starting the computer and the function of Grub.

The second case gives a way to recover a missing *Inittab* file. It is known that *init* is the first process running under Linux. This file also starts the run levels and if this file is deleted, the computer cannot be booted. Even single user

mode cannot be used to fix the problem. To solve it: first select the booting device to CD to enter into rescue mode. Then, find the RPM package initscripts-*.rpm in the SERVER directory of the CD-ROM. The third case is setting the Grub command. Through this case, students can know more about the functions of the Grub.conf file. In brief, all the cases help students easily acquire knowledge and they raise students' interest and initiative.

Applying the Task-Driven Method to Teaching

The task-driven method requires that computer practice be divided into specific tasks. By completing the tasks by themselves, students can understand how knowledge relates to their work. In the meantime, teachers should pay great attention to training students to master the knowledge. The learning process is aimed at sub-tasks. Students can master the knowledge required by the tasks in lectures, look up material and communicate with other students. Students should put into practice the analysis and solution of problems. This provides a sense of achievement and stimulates their craving for knowledge. Gradually, this can form a beneficial circle called perception of mental activity. This method can develop their independent exploration self-taught abilities.

Take the learning of the APACHE server configuration as an example. Students need to understand a serious of steps including server start, deployment, and the main directory concepts, Web site creation and testing and so on. So, teachers can allocate tasks as follows:

- Set up the APACHE server.
- Find sub-contents in the acquiescent Web and name it.
- Build a Web page named index.html with VI compile under sub-contents. The Web page contents can be arbitrary.
- After the configuration is completed, students open the browser to input: http://ip/~user name (for instance, http://192.168.196.129/zhangsan). The result is that the user can access the site. This requires students to check success using their IP address. This task is very interesting, has proved effective and students were highly enthusiastic.

Students are set an assignment to be undertaken in an enterprise. In this way, learning becomes more objective. In order to understand and master knowledge, students should link the specific task to relevant knowledge. Teachers make comments on the results. On the simulation experiment, teachers should aim to resolve common problems. In a word, assignment-driven models not only solve problems but also consolidate knowledge.

CONTRAST RESULTS

After the teaching material and methods are determined, assessment criteria should be set. The traditional written examination pays attention to theoretical knowledge but does not measure practical and application abilities. Theoretical ability is not equal to practical ability. Compared with other scholars, the following concrete measures were implemented:

- Cancel the traditional examination and pay attention to the process as well as the result.
- After reforming the course, the assessment consists of three parts, which are average score, task score and final examination. The average score includes attendance and performance, and is 20%. The task score is 30% and is awarded by the teacher for task achievement. The final examination is 50% given on the basis of a comprehensive task and personal summary.

There are disadvantages and advantages between the traditional teaching mode and the case study and task-driven methods. Examination results are shown for 2008 to 2012. A small-sized class of about 30 students was taught in the traditional mode in 2008, 2009; the case study mode in 2010; the task-driven mode in 2011; and a combined method in 2012. The results are shown in Figure 1.
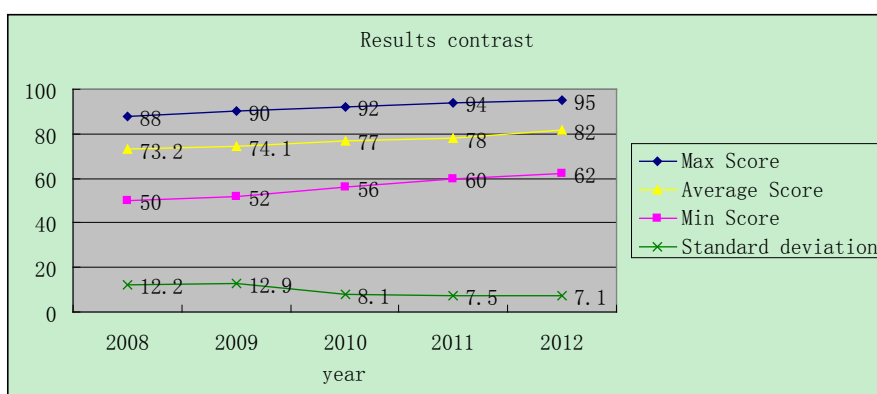

Figure 1: The students' scores from 2008-2010 grade.

In Figure 1, it can be seen that the maximum score, minimum score and average score kept increasing year by year from 2008. The maximum score, minimum score, average score and standard deviation did not change much in 2008 and 2009, since traditional teaching methods were used these years. In 2010, the case study method produced a better result than the previous two years. In 2011, the task-driven method produced an average score that is basically the same as in 2011. The case study and task-driven method together has produced an average score that is four points higher than in 2011. The standard deviations reduce year by year. This shows that student score differentiation is not big, and more and more students hope to learn Linux. The detail distribution of student scores is in Table 1.

Table 1: Student score distribution.

	A ($\geq$ 90)	B (80-89)	C (70-79)	D (60-69)	E (< 60)
2008	2 (6.7%)	5 (16.7%)	15 (50.0%)	5 (16.6%)	3 (10.0%)
2009	3 (10.05)	5 (16.7%)	14 (46.7%)	6 (20.0%)	2 (6.7%)
2010	4 (13.3%)	6 (20.0%)	16 (53.3%)	3 (10.0%)	1 (3.3%)
2011	4 (13.3%)	8 (26.7%)	15 (50.0%)	3 (10.0%)	0 (0.0%)
2012	5 (16.7%)	9 (30.0%)	15 (50.0%)	1 (3.3%)	0 (0.0%)

As Table 1 shows, in contrast to using the traditional method, the number of *A* grades increased by 10%. The number of *D* grades decreased 13.3%. Now there are no *E* grade students; *A*, *B* and *C* grades now account for 96.3%.

CONCLUSIONS

To improve the teaching of a Linux course, a case study and task-driven teaching methods were implemented, and are reported in this article. This breaks with the traditional mode, which still is most widely used. The new method encourages students to study, and to show initiative and co-operative behaviour. The scores have improved significantly and score distribution is more reasonable.

The new teaching mode strengthens the practical use of computers, lays a foundation for practical applications, and has led to a significant improvement in teaching outcomes. In the future, the authors will first develop optimisation analysis examples and other, useful tasks. Then, further useful teaching methods will be explored.

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